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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 65

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ANTENNAS

UDC 621.396.67

INVESTIGATION OF RESONANCE PHENOMENA IN A PHASED ARRAY ANTENNA WITH DIELECTRIC PLUGS

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1383-1391 manuscript received 5 Apr 79

IL'INSKIY, A. S. and TRUBNIKOV, S. V., Moscow State University

[Abstract] Resonance phenomena are typical for problems of propagation and diffraction of electromagnetic waves. The resonance effects are particularly clear when electromagnetic waves propagate in periodic structures such as phased antenna arrays. A direct projection method was previously used by the authors to solve the electrodynamic problem. This method makes it possible to obtain directly the energy characteristics of the field and the contribution of each component of its wave. The electromagnetic field in waveguides and in free space was investigated. The mechanism of formation of standing waves is explained, and phase relationships are derived for resonating waves. Figures 5; references 3: 2 Russian, 1 Western.
[127-8617]

UDC 621.396.67

MACHINE DESIGN OF WAVEGUIDE RADIATORS OF ARBITRARY CROSS SECTION FOR ANTENNA ARRAYS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 3-15 manuscript received 21 May 79

VOSKRESENSKIY, D. I., GRINEV, A. YU., IL'INSKIY, A. S. and KOTOV, YU. V.

[Abstract] The most complicated and labor-consuming stage in designing the radiator in an antenna array is the design of the radiating section. The authors illustrate a technique for realization of this stage by the example of waveguide radiators with arbitrary cross section. The technique uses strict electrodynamic analysis based on the projection method of matching

fields in order to determine the amplitudes of fields of waveguide and spatial harmonics, and the finite element method to find the complete system of waveguide harmonics. A numerical algorithm and computer program are worked out. Relations are given for the normalized coefficients of reflection and polarization characteristics as functions of the scanning angle, and partial radiation patterns are given for H-shaped, quadruple-ridged square and circular waveguide radiators in antenna arrays. A machine design method is given that utilizes a number of formalized criteria. Specific examples are given. Figures 5; tables 2; references 20: 12 Russian, 8 Western.
[185-6610]

UDC 621.396.67

DESIGN OF ANTENNAS WITH CONSIDERATION OF ISOLATION REQUIREMENTS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 31-38
manuscript received 21 May 79

LAVRUSHEV, V. N. and SEDEL'NIKOV, YU. YE.

[Abstract] An examination is made of individual special aspects of the problem of designing antennas with consideration of decoupling requirements, and certain possibilities of formulating and solving problems are discussed. The analysis is limited to discrete systems of radiators with matched and isolated excitation circuits. It is shown that the problems of optimum design of such antenna systems reduce to determination of coefficients that optimize the radiation characteristics of a group of antennas and that minimize coupling factors between separate antennas. The results show that the level of undesirable couplings can be considerably reduced with only slight detriment to other parameters. Examples of calculations and experimental verification are given. The proposed approach to optimum design of a group of antennas can be used in developing complex antenna systems, evaluating their limiting possibilities, and also in certain cases of ensuring electromagnetic compatibility of electronic facilities. Figures 8; tables 1; references 9: 8 Russian, 1 Western.
[185-6610]

UDC 621.396.67

INVESTIGATION OF DIRECTOR RADIATORS IN A CONVEX CYLINDRICAL ANTENNA ARRAY OF ARBITRARY SHAPE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 39-47
manuscript received 14 Mar 79

INDENBOM, M. V. and FILIPPOV, V. S.

[Abstract] On the basis of an asymptotic theory an investigation is made of the characteristics of a convex cylindrical antenna array of director radiators. A numerical projection method is used to find the current distribution on the dipoles of the radiators. It is shown that arbitrary excitation of a cylindrical array by a system of waves propagating in the feeders can be represented by a discrete Fourier transform in the form of a superposition of partial excitations with fixed amplitude and linearly changing phase. The field in the boundary layer of the cylindrical array is defined by a superposition of spatial harmonics constructed on the basis of methods of geometric optics and a parabolic equation with the use of local periodicity of the field. The field in the far zone is determined by quadratures based on the principle of equivalent currents. The radiation patterns of a director radiator in a cylindrical array is determined with consideration of interaction with adjacent radiators loaded by matched loads. The distribution of complex amplitudes of waves reflected into the feeders is found for sharply directional excitation of the antenna array. Figures 6; references 6: 5 Russian, 1 Western.
[185-6610]

UDC 621.396.67

RADIATION PATTERN OF AN ANNULAR SLOT ON A CONE WITH A DIELECTRIC SPHERE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 48-53
manuscript received 23 Feb 79

SHUNIN, O. A.

[Abstract] An examination is made of the external electrodynamic problem for an annular slot antenna with cophased magnetic current. The slot is located on the end face of an infinite metal frustum of a cone with a dielectric spherical tip. It is found that a reduction in the thickness of the dielectric layer improves the uniformity of the radiation pattern in the forward half-space. When the thickness of the layer as characterized by the product of the radius of the sphere and the wave number is 2.0 or less, the radiation

pattern is oriented chiefly toward the rear half-space when the ratio of permittivities of the internal region and external region is 4.0. Figures 4; references 7: 4 Russian, 3 Western.
[185-6610]

UDC 621.396.67

EXCITATION OF A CIRCULAR LATTICE MADE OF CYLINDERS WITH LONGITUDINAL SLOTS

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 202-212 manuscript received 26 Mar 79

VELIYEV, E. I. and SHESTOPALOV, V. P., Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] A new circular lattice is considered in which hollow circular cylinders with longitudinal slots are used instead of cylindrical rods. The low-frequency oscillation mode, which is an analog of Helmholtz resonance in acoustics, is of special interest. There is a similar situation for the considered circular lattice and the article is devoted to study of this case with excitation of the given structure by a magnetic current filament. Simple analytical formulas are derived for the surface current and radiation pattern density which determine the main properties of the considered lattice. Unique antenna designs can be developed by combining small wave dimensions of the components of the considered lattice and their resonance properties. Figures 4; references 11 Russian.
[191-6521]

UDC 621.396:677.001.57

OPTICAL SIMULATION OF RADIATION PATTERNS OF CORRELATIONAL ANTENNAS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 37-42 manuscript received 14 Apr 78

VINOGRADOV, G. K., VODOVATOV, I. A., VYSOTSKIY, M. G., YESEPKINA, N. A. and ZUBKOVA, T. I., Leningrad

[Abstract] Correlational antennas are pairs of antennas connected to a receiver so as to produce an output signal proportional to the correlation function of the signals received from each. Optical simulation is an effective method of analyzing the radiation pattern of antennas in general, and here it is applied to correlational antennas in particular. In this case it involves one optical multiplication of luminous flux distributions at least, or two optical multiplications with a subsequent addition of the products at most. The multiplication can be performed holographically, which is simple when the phase centers of both antennas coincide. The procedure becomes more complicated when their phase centers are apart and, when the distance between them is large, it becomes most expedient to restore the holograms from the photographically recorded interference pattern. More complicated procedures are applicable to pairs of antennas separated by a distance comparable with the dimensions of their switched sections. The effectiveness of this method has been confirmed in experiments with a Mills cross, the phase centers coinciding or far apart respectively, using SIN and UIG-2G-1 holographic equipment. Figures 6; references 7: 5 Russian, 2 Western (one translated).
[179-2415]

UDC 621.396.677.49

CALCULATION OF SEQUENTIAL PATTERN-FORMING SYSTEMS FOR ANTENNA ARRAYS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 86-88 manuscript received 3 May 78; after revision, 15 May 79

ALEKSEYEV, V. S. and SALOMATOV, YU. P.

[Abstract] An analysis is made of a sequential pattern-forming system for a multibeam antenna array. The proposed system takes the form of two sets of mutually intersecting transmission lines with directional couplers at the intersections. Design of such a system reduces to calculation of the amplitude-phase distribution in the j+1-th section of the system from the predetermined amplitude-phase distribution in the j-th section. The parameters of the

directional couplers on each of the horizontal transmission lines can be calculated from the amplitude-phase distributions preceding these lines. An engineering method is described for determining the amplitude-phase distribution preceding the horizontal transmission lines that does not involve inversion of high-order matrices, and enables prediction of additional losses in modes with switchable radiation patterns. Figures 2; references 3 Russian.
[185-6610]

UDC 621.396.677.861

THE PROBLEM OF SYNTHESIS OF OPTIMAL POLARIZED RADIATION PATTERN OF MIRROR ANTENNAS

Gork'kiy IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1377-1382 manuscript received 20 Nov 78

YURKOV, N. K., Penzensk Polytechnic Institute

[Abstract] The efficiency of polarization selection of signals from objects of radio astronomical observation against a background of intense polarized noise is greatly reduced in the presence of a parasitic connection between orthogonally polarized channels which occurs in mirror antennas of radio telescopes because of the cross-polarization effect. Cross-polarization in the emission of an antenna system has a negative effect on the coefficient of directional activity of an aperture antenna. A method is justified for synthesis of an optimum aperture antenna using matrix analysis of the operation of antenna systems. An amplitude phase distribution of the y-constituent of surface current of the counter-reflector is synthesized, which destroys the cross-constituent in emission of a two-mirror antenna system. The author expresses the deepest appreciation to D. M. Sazonov for interest in the work and for valuable critical remarks. Figures 4; references 6 Russian.
[127-8617]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE, CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 519.68:681.51:007.5

FAST IMAGE RECOGNITION WITH THE AID OF A GENERALIZED HARMONIC ANALYSIS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 10-18 manuscript received 24 Nov 78

TKHABISIMOV, D. K. and USIKOV, D. A., Moscow

[Abstract] The problem of fast image recognition, namely locating the reference image within the image of a non-negative bounded function in a plane with an integrable square, can be solved with the aid of a generalized Fourier analysis and subsequent approximations applied to the correlation function. This is demonstrated by a harmonic analysis of the correlation function in a homogeneous space with a group of movements, using the proper analog of the convolution theorem. The method is then applied to groups of translations, rotations, scale conversions, and their combinations. These groups are associated with integral transforms (Fourier, Mellin, Fourier-Bessel respectively), which can all be reduced to discrete Fourier transforms and thus evaluated much faster than by direct methods. In the case of an image given on a discrete NxN grid with both translations and rotations of the plane, for instance, the number of operations for calculating the correlation function is reduced from N^5 to $N^3\log_2N$. The authors thank M. L. AGRANOVSKIY, R. D. BAGLAY, L. S. GURIN, B. I. KOLOSOV and T. E. KRENKEL' for helpful discussions. References 13: 9 Russian, 4 Western.
[179-2415]

UDC 681.3.06:621.3.049.75.002

LOGIC METHOD OF CHECKING ELECTRICAL CONNECTIONS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 94-95 manuscript received 19 Jan 79

MARKIN, O. V. and SKOBOV, L. M., Kishinev

[Abstract] A formal method of checking electrical connections on blueprints is proposed, particularly useful for automatic design and layout of modern radioelectronic equipment. It makes use of tables where each row corresponds to an individual contact node in the given electric circuit. The circuit is subdivided into fragments at different potentials each, each one comprising a connection of two or more points at the same potential. These fragments are ranked according to the number of unconnected circuit parts to which they consist. They are entered in the table along with the corresponding circuit elements and contact points. Implementation of this method has been programmed on a YeS 1020 Unified System computer for automatic design of printed-circuit board topologies. Figures 5; tables 5; references 2 Russian.
[179-2415]

UDC 681.32.05

STATISTICAL MODEL OF BINARY IMAGES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 3-9 manuscript received 3 Jan 79

STARKOV, M. A., Novosibirsk

[Abstract] A model of binary images is proposed for use in image coding and recognition as well as for detection of objects submerged in noise and for construction of optimal algorithms. This model is a statistical one where the set of binary images forming a pattern on a uniform mXn matrix are referred to a principal set of points and the probability of realizing a binary "1" in the complementary set of points is calculated by solving a second-order linear difference equation of a zero-entropy problem. The algorithm yields the average number of bits required for coding, for instance, also the necessary and sufficient number of bits for computer-aided transfer of images. The real minimum is always larger than the ideal minimum and their ratio characteristizes the efficiency of this algorithm, 1.3 in the case of coding the image of digit "5." The author thanks V. R. KIREYTOV, O. YE. TROFIMOV and V. A. TSETSOKHO for their lively discussion and comments. Figures 2; references 2 Russian.
[179-2415]

UDC 681.325.57

COMPARATIVE ANALYSIS OF SEVERAL MULTIPLICATION METHODS. INSTRUMENTAL REALIZATION OF A SPECIAL-PURPOSE SEQUENTIAL-TYPE MULTIPLIER

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 43-54 manuscript received 20 Oct 78; final version 3 Jan 79

LUBKOV, A. A., Novosibirsk

[Abstract] The multiplication process consists usually of obtaining partial products and adding them. Special corrective steps are required in the case of different algebraic signs, moreover, but these do not affect the process. Methods of multiplication can be classified into sequential and parallel ones. In the first class belong addition-and-shift with testing of one or several digits (bits), an example being the modified Booth algorithm, and retention or transfer of the carry. In the second class belong accelerated addition of partial products (parallel addition with transfer of carries within each summator level or from one to another individual digit at different summator levels, reduction of the number of summands according to the binary law, Wallace addition) and reduction of the number of partial products (formation of partial products by accelerated addition, logic method, tabulation methods). A typical sequential multiplier of 32-digit numbers has been instrumentally realized on a single 240x280 mm^2 board, operating by the modified Booth algorithm with a speed of 2.5 us or better. Its structure includes a channel data receiver, a multiplicand register, a multiplier register, an arithmetic-logic device, a partial-products register, two sets of channel data transmitters, a decision making device, and a control device. There are no commutator and rectifiers between the multiplicand register and the arithmetic-logic device, because the former is a shift register and the latter can not only perform the operations A+B and A-B but also transmit A directly. All components are built with maximum possible microcircuit integration. The author thanks candidate in technical sciences A. N. KASPEROVICH and candidate in technical sciences I. I. KORSHEVER for useful comments made during reading of the manuscript. Figures 8; tables 1; references 11: 4 Russian, 7 Western.
[179-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

UDC 621.3.083.7

DELINEATION OF BOUNDARIES ON PHOTOGRAPHIC IMAGES

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR. SERIYA TEKHNICHESKIKH NAUK in Russian No 13(313), Issue 3, Oct 79 pp 117-121 manuscript received 16 Oct 78

BORISOV, A. N., PETRAKOVSKIY, I. A. and KHLEBOPROS, R. G., Institute of Forestry and Wood imeni V. N. Sukachev, Krasnoyarsk

[Abstract] A technique is proposed for analyzing aerial photographs with the Fosdak-1000 TV-type discrete densitometer. The method is based on the fact that the photographic image is a field of distribution of optical density corresponding to the field of brightness distribution of the photographed object. Information on the position of a boundary between two objects on the photographic image is obtained by checking the rate of motion of the boundary along the horizontal axis as a given quantization level is scanned along the vertical axis. The Fosdak-1000 densitometer images only that part of the aerial photograph with optical densities in a given range. Thus the technique can be used to distinguish the boundaries of relatively uniform natural formations. The detail in differentiation of uniform objects can be varied by changing the width of the quantization level. The algorithm of the method is simple, and can be readily computerized. Figures 4; references 3 Russian. [178-6610]

UDC 681.5:681.3.01

OPTIMIZATION OF THE TIME NEEDED FOR MAPPING SIMPLE PHOTOGRAM IMAGES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 31-36 manuscript received 12 Oct 78

IVANOV, V. A. and PUSHNOY, B. M., Novosibirsk

[Abstract] Several automatic systems analogous to the Zenith system are being developed and built which essentially consist of a 2-coordinate precision positioning drive with scanning and recording devices. They are controlled by medium-size or small computers, and the use of laser sources with small light spots and high speeds of commutation further widens their range of application. An important performance indicator of such a system is the total time of an image mapping operation and this parameter, obviously, needs to be optimized. Here this time is calculated for a simple square grid of rows (horizontal lines), in the ideal case of passing all nodal points in three possible modes: 1) point-by-point positioning, 2) constant velocity, 3) maximum acceleration. A possibility of optimizing it is then shown which allows for missing points and subsequently recovering them by reiteration after a complete scan of the grid. The analysis is based on random deviations of a "fixed" coordinate from its preset position, assumed to be principally caused by nonuniformity of dry friction, with a zero mean and triangular probability distribution. Histograms plotted on the basis of experimental optimizations tend to approach this distribution. Figures 1; tables 1; references 9 Russian.
[179-2415]

CERTAIN ASPECTS OF ASTRONOMY, SATELLITES AND SPACE VEHICLES

UDC 535.8:535.214.4

CENTIMETER RANGE RADIOMETER WITH INCREASED LONG-TERM STABILITY

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1401-1402 manuscript received 16 Mar 79

YEGORYCHEV, V. P. and KRASIKOV, A. V., Scientific-Research Radiophysics Institute

[Abstract] A major problem in radio astronomy is the study of radio emission fluctuations, especially solar radio emission, in order to obtain information on processes occurring in the plasma. The use of hybrid integrated circuits has enabled radiometer equipment to be developed further. The use of hybrid microwave components in the radiometer (Schottky barrier diode balance mixer, microstrip heterodyne and IF amplifiers) assures high reliability, stability and good reproducibility of the conveter parameters. A block diagram is elaborated in order to indicate the components of the system. The small dimensions and low weight of the device with its high reliability enable this high-frequency unit of the radiometer to be employed in systems of on-board radio navigation and thermal location, in radio communications systems, in mobile expeditionary radio telescopes and in the study of thermal radio emission of biological objects. Figures 2; references 3: 2 Russian, 1 Western. [127-8617]

UDC 621.396.628:523.164

WANT-TYPE RADIO TELESCOPE DEVELOPED AT SCIENTIFIC-RESEARCH RADIOPHYSICS INSTITUTE (NIRFI)

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1293-1300 manuscript received 18 Oct 78

MOSALOV, I. V., BAKHAREV, N. V., DUGIN, N. A. and TSEYTLIN, N. M., Scientific-Research Radiophysics Institute

[Abstract] Parabolic mirror antennas are a major instrument in radio astronomy, aerospace communications and some other technical fields and are widely utilized as independent instruments as well as components of complex antenna arrays. To increase the limits of possible dimensions of ground-based antennas and to reduce their weight, special mirror constructions have been designed. The Scientific Research Radiophysics Institute investigated the possible use of methods of "gravity-free" architecture in order to design the reflective surface of reflectors and, consequently, a new type of light mirror antenna was proposed which used pre-stressed Want-rod mirror structure and flexible grids and sheaves. The rigidity of the structure is assured with no significant increase in weight by using thin-walled tubes and hollow structures, and deformations are blocked by controlling the pre-stressing, efficient placement of supports and junctions, etc. The RTVS-12 radio telescope was designed for the decimeter wave range; but during operation, it became clear that the boundary of working wavelengths could be lowered. The mirror weighs only 1.3 tons, whereas mirrors of ordinary frame design weigh 2 to 4 times more. Figures 3; tables 1; references 9 Russian.
[127-8617]

CIRCUIT THEORY AND PRACTICE

UDC 538.56

DEFECTS AND IMPURITY DIFFUSION AND FLICKER FLUCTUATIONS OF THE NUMBER OF CARRIERS IN CONDUCTING MEDIA

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 238-243
manuscript received 15 May 79

YAKIMOV, A. V., Gor'kiy State University

[Abstract] A new model of flicker fluctuations in real objects is proposed which permits determination of the type and level of the spectrum of flicker fluctuations of the number of carriers in the working volume of the analyzed object. This model can be used to explain many fundamental properties of flicker fluctuations such as the level and frequency dependence of the spectrum, variation of its value and shape with variation of the ambient temperature. The basis of the model is analysis of the diffusion of impurity atoms and defects in the analyzed specimen which leads to generation of flicker fluctuations and which is a cause of thermodynamic aging of the given specimen. The results are in good agreement with known experimental data. The author is grateful to A. A. Dubkov and G. N. Bochkov for discussion of a number of aspects of the work, A. N. Malakhov for constant interest and support in conducting the investigation, as well as V. V. Potemkin for helpful comments with respect to the work. Figures 1; references 10: 5 Russian, 5 Western.
[191-6521]

UDC 621.3.078:621.373.072.9

PERIODIC MOTION OF THE SECOND KIND IN PULSE-PHASE AUTOMATIC FREQUENCY CONTROL SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 320-328
manuscript received 29 Dec 78

KULESHOV, V. N. and LEVCHENKO, G. M.

[Abstract] Pulse-phase automatic frequency control systems are used in radio communication, radar and television, where reliable locking to a given spectral component of the input signal can be very important. Here the existence of periodic, but other than synchronous, motion is considered in such a system with any odd characteristic of the phase discriminator and any type of low-pass filter in the feedback loop. The analysis is based on the fundamental equation of such a system for an input signal of constant frequency, which involves a discrete Laplace transform of the instantaneous phase difference and which with a piecwise linear characteristic of the phase discriminator reduces to a system of algebraic equations. The stability of the steady-state solution representing periodic motion at frequencies other than that of the given signal pulse component is now analyzed and several modes of motion are described where a phase lead of 2πk builds up in m cycles ($\nu_n = \phi_n - \alpha n = \phi_n - 2\pi\frac{k}{m}$. The simplest is locking at frequency $f_{syn} + \frac{1}{2} f_p$, in three possible variants, also two variants of locking at $f_{syn} + \frac{1}{3} f_p$ and one variant of locking at $f_{syn} + \frac{1}{4} f_p$ being possible. Figures 3; tables 1; references 7 Russian.
[189-2415]

UDC 621.372.011.72.53:72.51

METHODS OF CORRECTING THE VALUES OF ELECTRICAL PARAMETERS OF COMPLEX RADIO-ELECTRONIC DEVICES WITH THE USE OF POLYNOMIAL MODELS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 73-75
manuscript received 29 May 78; after revision 11 Mar 79

FROLOV, A. D.

[Abstract] In the development of a complex radioelectronic device one first establishes the nominal values of its electric circuit parameters and their tolerance limits on the basis of theoretical calculations and laboratory measurements, then corrects them on the basis of experimental prototypes or

pilot samples. Analytical methods are usually difficult and often impossible to use for that correction, while heuristic methods generally yield far from optimum values of the parameters. One relatively easy and efficient method of correcting the nominal values as well as their tolerances involves the use of polynomial models constructed from experimental data. Here a simple incomplete quadratic polynomial is considered whose first term is a function of all original parameters x_{j0} $(j = \overline{1,k})$, the second term is the sum of their weighted changes $b_j \Delta x_j$ $(j = \overline{1,k})$, and the third term is the sum of the weighted pairwise products of these changes $b_{jl} \Delta x_j \Delta x_l$ $(j \neq \overline{1, c_k^2} = k!/2!(k-2)!)$, all weighting coefficients b_j, b_{jl} being the model parameters determined from experimental data. Application of this method is demonstrated on the simplest case of two design parameters and then extended to several design parameters, also to the case of original design parameters with any one functionally related to several final parameters simultaneously. The method is comprehensive and much faster as well as much more optimal than the conventional method of "random search."
[174-2415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, INCLUDING RECEIVERS AND TRANSMITTERS; NETWORKS; RADIO PHYSICS; DATA TRANSMISSION AND PROCESSING; INFORMATION THEORY

UDC 535.36

THEORY OF PROPAGATION OF A NARROW LIGHT BEAM IN A STRATIFIED SCATTERING MEDIUM

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1310-1317 manuscript received 21 Nov 78

DOLIN, L. S. and SAVEL'YEV, V. A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] The field of brilliance of a directional emission source in media with extreme anisotropic scattering at optical distances not too far from the source can be calculated very well by solving the transfer equation in a small angle approximation. However, this solution assumes the uniformity of optical characteristics of the medium, whereas the optical characteristics of natural scattering media are generally three-dimensionally non-homogeneous. This solution is generalized to the case where the indicators of scattering and absorption of the medium and its indicatrix of scattering change arbitrarily along the route of beam propagation. The limits of applicability of the formulas derived are defined by the condition of smallness of the angular width of the body of beam brilliance. Figures 2; references 8: 7 Russian, 1 Western.
[127-8617]

UDC 535.42

PHASE GEOMETRY VARIATION OF A LIGHT BEAM IN ITS DIFFRACTION BY ULTRASOUND

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1356-1364 manuscript received 26 Feb 79

OSTASHEV, V. YE., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] Systems of equations for the amplitudes of spectra of various orders occurring in the diffraction of a plane light wave by ultrasound have been derived in many studies. Approximate solutions are investigated where the intensity of single scattering is small, and Bragg's condition is not satisfied. Primary interest was in the amplitude-phase multiplier of the spectrum of zero order e_0. For a plane light wave, the increment in phase due to ultrasound depends on the direction of propagation of this wave. If, however, a beam strikes the ultrasound, the plane waves appearing in its spectral expansion receive different increments in phase. A three-wave approximation is also derived. The author thanks V. I. Tatarskiy for constant attention to the work and helpful council, and A. M. Martynov, an author interested in the diffraction of light by ultrasound, who took part in discussion of the results obtained. References 10: 6 Russian, 4 Western.
[127-8617]

UDC 535.416.3

OPTIMIZATION OF LIGHT BEAM FOCUSING IN MOVING NONLINEAR MEDIA

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1318-1323 manuscript received 22 Jan 79

VORONTSOV, M. A. and CHESNOKOV, S. S., Moscow State University

[Abstract] Thermal self-reaction of light beams is a major factor hindering energy transmission over great distances. The direct application of coherent optical adaptive technique developed to compensate for linear distortion of the beam makes it somewhat possible to reduce thermal defocusing. Current methods of á priori phase correction are based on the calculation of the optical force of a distributed thermal lens aimed as a beam in a medium and subsequent compensation of its defocusing effect by an equivalent thin lens at the entrance to the medium. It is more promising to determine the initial phase profile of the beam during a numerical solution of the problem of optimization of focusing using gradient methods. Numerical realization of the algorithm of

optimum control of the phase profile of a light beam propagating in a moving nonlinear medium is carried out. The effectiveness of the algorithm is analyzed on the basis of the result obtained. Integral relationships are derived for a coupled system of equations which are suitable for an averaged description of the solution. The efficiency of the algorithm may be increased with a successful choice of an iteration procedure of correction of the phase front. Figures 4; references 8: 5 Russian, 3 Western.
[127-8617]

UDC 621.291.14:519.2

IDENTIFICATION OF RANDOM SIGNALS BY THE SPECTRUM OF THEIR REALIZATIONS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 16-22
manuscript received 28 Jul 78; after revision 19 Mar 79

OMEL'CHENKO, V. A., MATEVITSKIY, YE. O., BALABANOV, V. V. and BEZRUK, V. M.

[Abstract] Identification of random signals with incomplete á priori information is considered, assuming first a normal distribution. Their classification is based on a compression of primary indicators by a Carnaugh-Loewe transformation or on a multivariate discriminant analysis. The maximum-likelihood estimator applied to the resulting secondary indicators, with respect to which the distribution of signals is generally not normal, yields the asymptotically optimum decision rule. Identification systems built according to the respective algorithms of indicator processing have been evaluated experimentally, on a sample of six random signals, by simulation on a YeS 1050 Unified System computer in the FORTRAN language and with the aid of a 60-channel spectrum analyzer. Figures 2; tables 1; references 5 Russian; 1 Western in translation.
[174-2415]

UDC 621.371.25

SHORTWAVE SCATTERING WITH OBLIQUE PROPAGATION IN THE IONOSPHERE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 151-158
manuscript received 11 Mar 79

ZERNOV, N. N., Leningrad State University

[Abstract] The shortwave field of a transmitter is considered in the presence of inhomogeneities with low disturbance of dielectric permeability in the ionosphere. The case when the corresponding points are located on the earth's surface and on an oblique plane from the transmitter to the receiver is investigated with respect to ionospheric disturbances. The iostropic case is considered and the two-dimensional problem on propagation in a planal laminar undisturbed atmosphere is studied to simplify the derivation. For single-skip routes on the order of 1,000 kilometers long at frequencies on the order of 10 MHz, the approximation of plane waves is suitable when describing scattering by inhomogeneities with a total dimension not exceeding units of kilometers. The final steepness of the emitting and secondary field fronts must be taken into account for larger disturbances. Formulas of geometrics optics are applicable if the typical scale of variation of the properties of the disturbance is on the order of 10 kilometers or more. Diffraction effects must be taken into account for disturbances with typical scales in the range of 1-10 kilometers. Figures 1; references 8 Russian.
[191-6521]

UDC 621.391.2

DIADIC-GROUP STRUCTURE OF A FAST DATA SEARCH SEQUENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 427-428
manuscript received 3 Jul 78

LOSEV, V. V.

[Abstract] Fast data search sequences are used for synchronization of radio engineering systems, for telemetry and for data transmission. Such sequences are $N=2^n$ symbols long and constitute functions based on a diadic group, i.e., a group of binary numbers with a common element t. An analysis of their structure reveals, in the form of the three theorems proved here, that all in a set of these sequences can be produced by diadic shifting of a single sequence. One of the theorems pertains to diadic shifting within a subgroup. This characteristic of fast data search sequences makes them processable by methods of harmonic analysis on finite intervals. References 5: 3 Russian, 2 Western.
[189-2415]

UDC 621.391.8

CHARACTERISTICS OF DETECTION OF A QUASI-DETERMINISTIC SIGNAL IN THE CASE OF BACKGROUND INTERFERENCE WITH AN UNKNOWN CORRELATION MATRIX

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 296-303 manuscript received 11 Dec 78

KORADO, V. A.

[Abstract] A quasi-deterministic signal with a random amplitude within a finite complex vector (multichannel) sample is considered and a normally distributed interference with an unknown pXp Hermitian correlation matrix. The efficiency and the power function (probability of correct detection) of several detection rules, depending on the probability density distribution parameters, are calculated and compared. These decision rules include the minimax test, found to be most efficient, and the maximum-likelihood ratio test, also found to be very efficient, the local minimax test and three quasi-optimal tests. The author thanks L. F. KALACHEV for making all the necessary computer calculations. Figures 2; tables 6; references 4: 2 Russian, 2 Western.
[189-2415]

UDC 621.391.8

QUASI-OPTIMAL FEATURES OF THE 'BILATERAL CONTRAST' METHOD USED FOR DETECTION OF A FLUCTUATING SIGNAL SUBMERGED IN NOISE OF ANY POWER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 425-427 manuscript received 4 Apr 78

BELETSKIY, YU. S.

[Abstract] The method of bilateral contrast using a 3-channel detector is considered for detection of a fluctuating signal submerged in noise with an unknown energy spectrum. Its interference immunity is estimated, taking into account the different frequency resolving powers of the center (signal) filter and the two lateral (contrast) filters. The probability of false detection is found not to depend on the noise power but to depend only on the threshold level of the contrast function according to the Neyman-Pearson criterion, and on the ratio of contrast channel bandwidth to center channel bandwidth. The probability of correct detection depends also on the signal-to-noise ratio in the center channel. For detecting a quasi-harmonic signal submerged in normal additive noise with a zero mean and an arbitrary power

level, this method becomes quasi-optimal with a finite measuring time and with either at least 5x2 contrast channels or with a ratio of contrast channel bandwidth to center channel bandwidth of at least 6. Figures 2; references 4: 3 Russian, 1 Western.
[189-2415]

UDC 621.391.8:510.5

A QUASI-OPTIMAL DETECTION ALGORITHM FOR A DETERMINISTIC SIGNAL APPEARING WITH NONGAUSSIAN INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 304-312 manuscript received 8 Jan 79

PYSHKIN, I. M. and CHVILEV, G. D.

[Abstract] The problem of detecting a signal which appears with interference in radio systems operating under conditions of á priori indeterminacy can be reduced to calculating the likelihood ratio and comparing that to the threshold. In the case of nongaussian interference it is convenient to consider a multialternative situation at the receiver input. Here a signal is assumed to appear together with additive interference consisting of white Gaussian noise and interstation interference. A table of four states with corresponding four hypotheses and four á priori probabilities is, by proper assignment of penalty values, reduced to two nonintersecting sets of two subsets each. An algorithm of calculating the respective likelihood ratios, in logarithmic and explicit forms, is shown for the case of an inertialess nonlinear element whose characteristic can be approximately piecewise linearized. The detector structure is designed which realizes this algorithm and its interference immunity is evaluated in terms of error probability and of the signal-to-noise ratio at the output of the nonlinear element. The authors thank O. A. SHORIN for assistance in the work. Figures 4; references 4 Russian.
[189-2415]

UDC 621.391.82.029.4:519.2

PROBABILITY CHARACTERISTICS OF A FLUX OF VERY-LOW-FREQUENCY SPIKES IN ATMOSPHERIC RADIO INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 280-289 manuscript received 31 Jan 79

DOBRYAK, D. S. and PETROVA, L. G.

[Abstract] The spike component of very-low-frequency (ONCh) atmospheric radio interference is described, in the group model, as a flux of random events with a Poisson distribution of nonconverging points. This description is accurate for short observation periods. The generating functional and the generating function of this flux are established on this basis. Calculations involving the Khinchin density show that, after an observation period sufficiently long probabilistically, this Poisson flux asymptotically approaches the Poisson-Poisson flux of an earlier model and, therefore, can be used for interpretation of known experimental data. The results of this analysis are used for determining the distribution of the time intervals between successive random atmospheric interference pulses such as thunder. Figures 4; references 9: 5 Russian, 4 Western.
[189-2415]

UDC 621.391.161

EFFECT OF MODULATING INTERFERENCE ON SPACE-TIME PROCESSING OF SIGNALS WITH SPHERICAL WAVE FRONTS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 10-15 manuscript received 19 Oct 78; after revision 16 Apr 79

GERMAN, A. M. and NAKHMANSON, G. S.

[Abstract] The problem of locating a target within the Fresnel zone of the receiver antenna is considered in the case where the signal becomes distorted during propagation by spatial modulating phase interference and appears at the receiver together with additive Gaussian white space-time noise. The antenna is assumed to be a straight one of finite length and the receiver is assumed to be optimal for signals with white noise. Calculation of the measured range and angle coordinates reveals an appreciable increase in the dispersion of results caused by such interference. The dispersion does not depend on the signal energy, however, and will not decrease with an increase of

the latter. However, the dispersion of range estimates will decrease and thus the accuracy of range measurements will improve with a larger signal bandwidth factor. Figures 2; references 4 Russian.
[174-2415]

UDC 621.391.161

DIGITAL NONCOHERENT RECEPTION IN DATA TRANSMISSION SYSTEMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 23-28
manuscript received 3 Jul 78; after revision 19 Mar 79

BELYAVSKAYA, T. G., LEVCHUK, YU. P., STRIGINA, YE. V. and YAKOVLEV, L. A.

[Abstract] The feasibility is established of noncoherent reception of harmonic signals in data transmission systems such as carrier-frequency or relative-phase telegraphy with the aid of fast-response recursive digital matched filters which operate in the quadrature mode with the necessary accuracy in real time, the accuracy being defined in terms of the absolute difference between the signal envelopes at the output of an analog filter and of a digital filter respectively. The synthesis of such a filter is, accordingly, treated as an approximation problem and selection of the proper discretization interval. The design algorithm has been programmed on a digital computer and checked on an already built data transmission channel. Figures 3; references 5 Russian.
[174-2415]

UDC 621.396.94.537.874.3

SIMULTANEOUS MEASUREMENTS PERTAINING TO METEOROLOGICAL CONDITIONS OF RADIOWAVE REFRACTION AT TWO POINTS 100 KM APART

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 407-409
manuscript received 18 Aug 78

RUKINA, A. N.

[Abstract] Gradients of the refractive index across the atmospheric layer between 120 and 300 m above ground have been measured at two points 100 km apart: Obninsk (Kaluzhskaya oblast) and Ostankino (Moscow oblast). Here a correlation is sought between the respective readings, on the basis of data on the atmospheric pressure, temperature and humidity. Into consideration are taken variations of the refractive index and its gradient in time, over a diurnal period, and in space. The correlation factor for the refractive index is found to be 0.8, but no correlation is found between readings of its gradient. Evidently, the atmosphere within the 300 m thick ground layer cannot always be regarded as spherically layered over a distance of 100 km. Figures 4; references 7 Russian.
[189-2415]

COMPONENTS AND CIRCUIT ELEMENTS, INCLUDING WAVEGUIDES, CAVITY RESONATORS AND FILTERS

UDC 621.372.2

SPECIAL FEATURES IN THE SYNTHESIS OF ACTIVE CAPACITIVE-SWITCH FILTERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 78-79
manuscript received 3 Jul 78

DOMBROVSKAYA, S. I. and MIROSHNICHENKO, S. I.

[Abstract] Because of the similarity between the characteristics of active resistive-capacitive filters and active capacitive-switch filters, it is expedient to synthesize the latter according to the already well developed procedure for synthesizing the former and to make the appropriate substitutions of parameters. The following 3-step algorithm of synthesis is proposed for an active capacitive-switch filter consisting of simultaneously switched two-pole networks: 1) Synthesize an equivalent RC filter with the required transfer function in the s-plane; 2) In the passive section of the equivalent filter, substitute for each capacitance a twopole network with the impedance $\hat{Z}= T(1+ s)/2Cs$ and for each resistance a capacitive-switch twopole network with the impedance $\hat{Z}= T(1+ s)/2C$; 3) and replace the active element in the equivalent filter with a corresponding active capacitive-switch element, by replacing the resistances with elements whose equivalent impedance is $\hat{Z}= T/C$ in the case of an active element with a dimensionless transfer ratio, or with elements whose equivalent impedance is $\hat{Z}= T(1+ s)/C$ in the case of an active element whose transfer function has the dimension of impedance or admittance. Such a synthesis results in fewer active elements than the conventional synthesis through an equivalent LC filter whose elements are simulated on the basis of capacitive-switch converters with negative resistance. No stability and sensitivity analysis of capacitive-switch filters built according to the proposed method has been made. Figures 1; references 3: 2 Russian, 1 Western.
[174-2415]

UDC 621.396.6

AN ALGORITHM OF SYNTHESIS FOR A PHASE CORRECTING SYSTEM OF FILTERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 36-41 manuscript received 18 Sep 78; after revision 30 Jan 79

TSUKANOVA, N. I.

[Abstract] A new algorithm is proposed for synthesis of a phase correcting network. The frequency characteristic of the group delay time of the four-pole network to be corrected can be given in analytical, graphical, or tabular form. The synthesis of a phase correcting system of filters for such a network is a minimax problem reducible to a system of inequalities which, upon discretization, can be solved successively as a problem in nonlinear programming. The algorithm uses the penalty function, which removes restrictions on the final state and on the dimensionality of the state-variables vector. It also uses the conjugate vector and the Hamiltonian, as in methods of optimization of discrete processes. This algorithm has been programmed on an ODRA 1204 digital computer in the ALGOL 1204 language. Typical calculations according to this algorithm for the synthesis of two delay lines, a 1.4 μs one covering the 0-6 MHz frequency range with 6 corrective filter sections and an 8.9 μs one covering the 0-3 MHz frequency range with 19 corrective filter sections, were found on a NAIRI-K computer to be more accurate and much faster than by the semiautomatic method. Figures 1; tables 1; references 6 Russian.
[174-2415]

UDC 621.391.266

A COMPRESSION FILTER WITH OPTICAL PUMPING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 430-433 manuscript received 11 Jul 78

ARZUMANOV, V. N., DUDKIN, V. I., PETRUN'KIN, V. YU. and SEMENOV, V. V.

[Abstract] Filters for compression of wideband pulse signals have been developed which utilize the spin echo effect, and also optical pumping in order to ensure a higher transmission ratio. An experimental study was made of such a filter with optical pumping of cesium vapor with argon as the buffer gas under a pressure of approximately 5 torrs. The standard equipment included two mutually perpendicular optical channels and a stack of Helmholtz rings

producing a constant magnetic field perpendicular to the pumping light beam. Radio pulses without and with linear frequency modulation were fed from an oscillator to an r-f coil oriented with its axis perpendicular to the magnetic field. Measurements were made over the 0.2-1 MHz frequency range, spin echo signals becoming too weak at higher frequencies because of the photoreceiver inertia. The compression effect was recorded on an oscillograph. It is suggested that optical excitation of spin precession will improve the filter performance and that use of lasers as sources of pumping will also widen the frequency range of compressible pulse signals. Figures 2; references 7: 3 Russian, 4 Western.
[189-2415]

UDC 621.372.8.09

DIFFRACTION OF AN H_{10} WAVE BY A DIELECTRIC STEP

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 213-218
manuscript received 15 Jun 79

BOGDANOV, F. G. and KEVANISHVILI, G. SH., Tbilisi State University

[Abstract] Using the projection method, the electrodynamic problem is reduced to an infinite system of linear inhomogeneous algebraic equations of second kind which permits solution by reduction and interation methods. The proposed version of the projection method is similar to that described previously because two groups of orthogonal functions on a given interval are used as the basic functions. Equations are derived in order to explain the scattered field arising in a waveguide as a result of wave diffraction on a dielectric step. Figures 5; tables 1; references 5 Russian.
[191-6521]

UDC 621.372.413

CALCULATION OF THE ELECTRODYNAMIC CHARACTERISTICS OF DIELECTRIC RESONATORS WITH FREQUENCY TUNING BY DIELECTRIC DISKS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 60-66 manuscript received 5 Jan 79; after revision 30 Mar 79

CHERNIY, B. S.

[Abstract] In contrast to frequency tuning of dielectric resonators by metal disks, tuning by dielectrics with low losses is not noticeably detrimental to the Q of the oscillatory system. The author studies the band properties, temperature stability and Q of a system containing a dielectric resonator and a dielectric disk for symmetric H-modes. Expressions are derived for the resonant frequencies of H-modes, the temperature coefficient of frequency and the Q of the system when the tuning element is coaxial with the resonator cavity, and the computational technique is generalized to the case of a dielectric resonator above a metal screen with a dielectric backing. The results are compared with experimental data. Figures 4; references 2 Russian.
[185-6610]

UDC 621.372.81

INTERACTION OF AN ELECTROMAGNETIC WAVE WITH A MOVING SEMI-INFINITE ANISOTROPIC MEDIUM IN A WAVEGUIDE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 96-100 manuscript received 10 Apr 79

KAPCHINSKIY, M. I.

[Abstract] The problem of interaction of an electromagnetic waveguide wave with a moving semi-infinite isotropic medium was solved in a previous article [E. D. Gazazyan, E. M. Laziyev, and A. D. Ter-Pogosyan, "IZV. VUZ: Radiofizika," Vol 21 No 10, 1978 p 1517]. In this paper it is shown that the same method can be generalized to the case of the simplest anisotropic medium: a uniaxial crystal with the principal optical axis parallel to the waveguide axis. An analysis is made of the reflection and refraction of waveguide E-waves on the boundary of such a medium. Expressions are found for the transverse field components in terms of the longitudinal components, and formulas are derived for frequencies and amplitudes of reflected and refracted waves.

A detailed analysis is made of reflection from a magnetized electron beam. Conditions are found for amplification of the reflected wave and for total reflection. It is shown that in the case of total reflection, amplification is possible only on transcritical currents. The author thanks L. A. Yudin for interest in the work and discussion of the problems raised. References 3 Russian.
[155-6610]

UDC 621.372.413

A CAVITY RESONATOR WITH POLARIZATION-CONTROLLED COUPLING

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 101-103
manuscript received 13 Oct 78

YANOVSKIY, M. S., KNYAZ'KOV, B. N. and KULESHOV, YE. M.

[Abstract] Fabry-Perot cavity resonators are used for making wave meters, filters, passive frequency standards and discriminators in the millimeter and submillimeter wave bands. A modification of this arrangement is a cavity with a reactive switching circuit that contains a coupling element in the form of a thin dielectric plate placed in the cavity at an angle of 45° to the longitudinal axis. Coupling with the cavity is varied by changing the thickness of the plate or its permittivity. In this paper the authors consider a cavity resonator with polarization coupling that can be more conveniently controlled between the input and output line sections. In the diagonal plane of a symmetric branch in a hollow dielectric waveguide is a one-dimensional wire grating with period much smaller than a wavelength. In the arms of the branch are right-angled dihedral reflectors that cover the entire circular cross section of the line with their faces at an angle of 45° to the waveguide axis. These reflectors are equipped with devices for adjusting the angle of turn relative to the waveguide axis in order to control coupling with the input and output sections, and also for adjusting displacement along the waveguide for tuning. Electrodynamic calculations are given. Figures 1; references 2: 1 Russian, 1 Western.
[185-6610]

UDC 621.372.822.09

PROPAGATION AND RADIATION OF WAVES IN RECTANGULAR WAVEGUIDES WITH STRATIFIED WALLS

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1365-1376 manuscript received 24 Jan 79

MANENKOV, A. V., Institute of Physics Problems, USSR Academy of Sciences

[Abstract] Open waveguides in which wave propagation is accompanied by emission are promising for systems of one-dimensional radar, especially for remote control and communications. The use of waveguides with emitting waves makes it possible to determine the coordinates and velocity of objects located near the waveguides and to communicate with these objects. These structures have a non-directional emission field which is undesirable in some cases. Lines of transmission of rectangular cross-section whose two walls are metallic and whose other two walls are dielectric are investigated. These waveguides possess a necessary directionality of the radiation field. The fields and coefficients of wave attenuation are investigated. The finite width of the metallic walls is calculated. The emission field is investigated as it applies to remote control systems. The author is grateful to P. L. Kapitsa, L. A. Vaynshteyn, V. N. Melekhin for valuable comments and B. Z. Katsenelenbaum and Ye. L. Kosarev for discussion of questions connected with this work. Figures 7; tables 1; references 18: 10 Russian, 8 Western.
[127-8617]

UDC 621.372.826

CALCULATION OF A RADIALLY INHOMOGENEOUS DIELECTRIC WAVEGUIDE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 92-94 manuscript received 16 Nov 78

PRUDKIY, V. P. and TERENT'YEV, YU. M.

[Abstract] Advances in production of inhomogeneous low-loss fibers have made it necessary to study the normal modes of axially symmetric guiding systems with permittivity that depends on radius, i.e., radially inhomogeneous dielectric waveguides. Traditional approaches to the calculation of wave modes in such systems are inadequate from the standpoint of accuracy. In this paper the authors examine the causes for loss of accuracy, and propose an effective method for analyzing the normal modes of radially inhomogeneous dielectric waveguides. It is shown that the proposed technique

improves the accuracy of electrodynamic calculations by two orders of magnitude compared with known results of calculation of the scalar problem. The propagation constant calculated by the proposed method is exact within 10^{-6}. The technique is also more efficient with respect to machine time than conventional methods of calculating optical waveguide parameters. Figure 1; references 11: 5 Russian, 6 Western.
[185-6610]

UDC 621.372.852.3:621.832

AN ELECTRICALLY CONTROLLED WIDE-BAND WAVEGUIDE ATTENUATOR WITH SHORT INTERACTION SPACE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 54-59
manuscript received 22 May 79; after revision 18 Jul 79

AL'TSHULER, YU. G. and USOV, N. YU.

[Abstract] Wide-band semiconductor attenuators based on longitudinally distributed p-i-n structures are extensively used in microwave devices designed for continuous electrical signal control. In the shortwave region of the microwave band, the interaction space of such attenuators is usually an order of magnitude or more longer than the wavelength of the wave being propagated. In this paper the authors consider the feasibility of reducing the length of the interaction space by microwave signal control using two longitudinally distributed p-i-n structures placed at different distances from the longitudinal axis of the waveguide. Calculations and experiments show that symmetric placement of two longitudinally distributed p-i-n structures at a certain distance from the longitudinal axis of the waveguide can considerably increase the inserted attenuation as compared with a single structure on the axis with the same dimensions of the interaction space and the same control current density. This arrangement can be used to shorten the attenuator while retaining high effectiveness of signal control. The electrodynamic parameters of the interaction space can be varied over certain limits by changing the distance between the p-i-n structures. In case of necessity, the wave impedance of the interaction space can be increased by making the narrow wall wider. For this purpose, n-i-p-i-n structures can be used for control, or else several p-i-n structures can be connected in series. Figures 3; references 10: 9 Russian, 1 Western.
[185-6610]

UDC 621.372.826

ANALYSIS OF SINGLE-MODE OPTICAL RING WAVEGUIDES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 3-9
manuscript received 14 Feb 78; after revision 19 Jan 79

ANDRUSHKO, L. M. and NAUMENKO, K. P.

[Abstract] Under consideration are single-mode multilayer ring (tubular) waveguides, produced by deposition from the gaseous phase and characterized by a radial profile of dielectric permittivity dipping at the center of the core. The performance of such waveguides, i.e., the propagation of electromagnetic waves is analyzed by the method of partial regions and the problem is reduced to a Bessel equation for the longitudinal field components in each layer. The boundary conditions in an N-layer waveguide yield a system of linear algebraic equations of the 4(N- 1)th order for asymmetric waves and of the 2(N- 1)th order for symmetric waves. The electric energy, the magnetic energy, as well as the group velocity and the power losses are then calculated. A numerical solution for six 6-layer waveguides with different layer parameters but sufficiently closely approximating a smooth parabolic permittivity profile has been obtained with the aid of a BESM-6 computer. A 0.4 wide and 0.66 deep permittivity dip is found to extend the transverse range of the electromagnetic field without significantly affecting the cutoff frequencies of adjacent modes, i.e., the bandwidth of single-mode operation. Figures 4; references 8: 4 Russian, 4 Western.
[174-2415]

UDC 621.378.9

INVESTIGATION OF LUMINOSITY LOSSES IN A THIN-FILM WAVEGUIDE WITH A SILICON BACKING

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 52-55
manuscript received 16 Jan 79

BYKOVSKIY, YU. A., KUL'CHIN, YU. N., ROZOVSKIY, M. O., SMIRNOV, V. L. and STAROS, F. G. [deceased], Moscow Engineering Physics Institute

[Abstract] Optical communication and data processing lines require combined integrated-optical and microcircuit systems in which optical elements have to be located on silicon backings that generally absorb the radiation used in optical systems. In previous research on luminosity losses in waveguides on silicon backings, the expressions derived for calculating losses were

rather complicated. In this paper the authors study losses of luminosity in thin-film waveguides on silicon backings with silica buffer layers of various thickness. An investigation is made of the way that losses in the waveguide layer are affected by the use of photolithographic processes on the backing to produce microcircuits. Light from a helium-neon laser was coupled out of the waveguide by a prism moving along the track of the light wave in the film, and the output emission from the waveguide was simultaneously measured by a photomultiplier, after which the difference was used to calculate the losses of luminosity. It is found that luminosity losses are acceptably low when the buffer layer is 1 µm thick. In a combined integrated-optical circuit the luminosity losses in the optical waveguide with a 1 µm buffer layer are increased by a factor of 3-4. Losses in combined systems with a photodetector matrix and optical waveguide are acceptably low when the buffer layer is 0.5 µm thick. Figures 2; references 7: 4 Russian, 3 Western.
[155-6610]

UDC 621.378.9+621.376

OPTIMIZATION OF THE EFFICIENCY OF DIFFRACTIVE LIGHT ENTRY INTO A 4-LAYER WAVEGUIDE SYSTEM

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 65-74 manuscript received 20 Oct 78; after final revision 11 Jan 79

VASIL'YEV, V. V., GURTOVA, T. V., DULIN, S. A., PAN'KIN, V. G. and POKROVSKIY, L. D., Novosibirsk

[Abstract] Diffractive entry of electromagnetic radiation into thin-film waveguides is the simplest and least variable technique available for use in integrated optics. In multilayer systems such as Si-SiO_2-$Si_xO_yN_z$-air it is possible for the optics and the electronics to be coupled. Here the efficiency of entry with the aid of a diffraction grating is calculated theoretically, assuming all these four layers to be transparent to light with refractive index n_4 (substrate) $\geq n_2$ (thin film)$>n_3$ (buffer)$>$ n_1 (air) and the buffer layer to be sufficiently thick to prevent significant leakage through it by tunneling. The problem is treated as a two-dimensional one and is solved for the simple case of only two diffracted light rays exiting: one through air and one through the substrate. The diffraction grating can be placed on the waveguide-buffer boundary or on the waveguide-air boundary, and the thicknesses of the waveguide (thin film) and the buffer layer can be optimized accordingly for maximum efficiency in each case. Experimental data pertaining to the TE_0-mode at the λ = 632.8 nm wavelength indicate maximum efficiencies

of 72 and 53 percent respectively in each case. A sufficiently close agreement between experimental and theoretical data, within measurement accuracy, could only be obtained after also the variation of thicknesses, especially of the buffer layer but also of the waveguide layer, had been determined, with an ellipsometer, and taken into account in the evaluation of results. The authors thank V. P. POPOV for the preparation of waveguide structures and K. K. SVITASHEV for the helpful suggestions. Figures 5; tables 1; references 9: 3 Russian, 6 Western (one in translation).
[179-2415]

UDC 681.7.068.4:666.192

LIGHT GUIDE WITH A LIGHT CONDUCTING CORE MADE OF INDUSTRIAL-GRADE QUARTZ GLASS AND WITH A POLYMER SHELL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 258-261 manuscript received 19 Jun 79

GRIGOR'YANTS, V. V., DETINICH, V. A., ZHABOTINSKIY, M. YE., MILYAVSKIY, YU. S., MINKOVICH, V. P., NANUSH'YAN, S. R., PETROVSKIY, G. T., SIMANOVSKAYA, YE. I., STEPANCHUK, V. I. and CHAMOROVSKIY, YU. K.

[Abstract] Quartz-polymer light guides were produced by extrusion of the cores and cladding them with polymer film. Cores of quartz glass were produced in two sizes: 200 μm in diameter from rod stock with a loss factor of 10 dB/km and 400 μm in diameter from rod stock with a loss factor of 30 dB/km. For the 50 μm thick cladding an organosilicon polymer was used with a refractive index of 1.4 and with absorption peaks due to OH^- groups at the 0.725, 0.875 and 0.95 μm wavelengths. A spectral analysis of the transmission characteristic, made with a UNICAM spectrophotometer, indicates that such a cladding does not affect the loss spectrum of the fiber significantly, not any more than borosilicate cladding, over the 0.55-1.0 μm range of wavelengths. Figures 2; references 9: 4 Russian, 5 Western.
[189-2415]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.316

SYNTHESIZING AN OPTIMUM QUASI-SINUSOIDAL SIGNAL

Unknown ELEKTRONNOYE MODELIROVANIYE in Russian No 2, 1980 pp 43-48 manuscript received 3 May 79

KALNIBOLOTSKIY, YU. M., SOLODOVNIK, A. I. and BONDARENKO, V. N.

[Abstract] Static converter circuits are synthesized by the given shape of the output signal. The structure of a static converter can be synthesized in the form of three main steps--approximation of the output signal of the converter by linear combination of easily realizable functions, synthesis of the structure of a static converter based on a derived linear combination of functions and engineering development of the synthesized structure. Equations are derived which permit calculation of the spectrum of any Walsh function and information only about the number of the function is required. Specific relations can be used as a function of the postulation of the problem and the required accuracy. An optimum quasi-sinusoidal signal which meets the proposed requirements can be found by using the given algorithm and information about the spectrum of Walsh functions included in the approximating polynomial. Figures 5; references 10 Russian.
[186-6521]

UDC 621.333:621.337.41

EFFECT OF DEVIATIONS OF CAPACITOR AND CHOKE PARAMETERS FROM NOMINAL VALUES ON THE ELECTROMAGNETIC PROCESSES IN FILTERS OF PULSE-TYPE CONVERTERS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 2, Feb 80 pp 199-201 manuscript received 19 Sep 77; after completion 18 Jul 79

KAREV, ANATOLIY VASIL'YEVICH, engineer-trainee, Higher Transport School (CSR); KAYARI, YENI PAULOVICH, engineer, Director of Laboratory, Tollinsk Electrical Engineering Plant; FEOKTISOV, VALERIY PAVLOVICH, candidate of technical sciences, Dotsent Moscow Institute of Railroad Transport Engineers; CHAUSOV, OLEG GEORGIYEVICH, candidate in technical sciences, Chief of Design Bureau, Tollinsk Electrical Engineering Plant; PATVAKANOV, SERGEY, junior research worker, Moscow Institute of Railroad Transport Engineers; and CHUVERIN, YURIY YUR'YEVICH, candidate in technical sciences, senior scientific research worker, Moscow Institute of Railroad Transport Engineers

[Abstract] LC-filters consisting of n identical Γ-sections are used for smoothing the current pulsations in the rail circuit with a pulse regulation system for operation of electric trains. Here a tolerance analysis is made to determine how deviations of capacitances and inductances from nominal values affect the filter performance in terms of the fundamental current component at full load and during short circuit. The derivatives of current with respect to inductance and with respect to capacitance are expressed in terms of finite differences, for numerical rather than analytical evaluation with the aid of a computer. Typical results for a filter in a 3 kV electric train supply system indicate that the cumulative effect of tolerances in an $n = 2$ section LC-filter is to increase the short-circuit current by 18-24 percent. This effect will be reduced as the number of filter sections is increased. Figures 2; references 3 Russian.
[187-2415]

UDC 537.312.62

INVESTIGATION OF A RESISTIVE RING CLOSED BY A LOW-CAPACITANCE JOSEPHSON JUNCTION

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR. SERIYA TEKHNICHESKIKH NAUK in Russian No 13(313), Issue 3, Oct 79 pp 109-116 manuscript received 13 Feb 78

RYCHKOV, S. N., Computing Center, Siberian Branch, Academy of Sciences USSR, Krasnoyarsk

[Abstract] Systems with Josephson junctions are extensively used as highly sensitive pickups in magnetometers, galvanometers and gradiometers with sensitivity of 10^{-8} Gs, 10^{-17} V and 10^{-11} Gs/cm respectively. Because of their high switching rate and packing density, as well as their low switching energy, these elements are widely used in LSI chips. A resistive loop closed by a Josephson junction is one of the widely used systems in such measuring instruments. In this paper the dynamics are studied of a ring of arbitrary resistance closed by a Josephson junction with low capacitance. The analysis reduces to a study of a system of two first-order nonlinear differential equations. Since self-oscillatory processes play an important part in such devices, principal emphasis is placed on periodic solutions, their stability. and also processes of transition from a state of equilibrium to a limiting cycle and the reverse. Analytical expressions are found for the frequency of oscillations, the time of transient processes and other quantities for the case where the characteristic value of the effective inductance of the junction is much greater or much smaller than the inductance of the loop. Figures 3; references 10: 9 Russian, 1 Western.
[177-6610]

UDC 537.312.62:621.385.6

LOW-FREQUENCY NOISE IN JOSEPHSON JUNCTIONS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 381-384
manuscript received 19 Dec 78

GUBANKO, V. N. and TARASOV, M. A.

[Abstract] The fluctuation sensitivity of a Josephson junction in a microwave detector, mixer, or amplifier is limited by noise affecting both its current-voltage characteristic and differential resistance. Here the particularly detrimental low-frequency noise is analyzed and the dependence of its amplitude, voltage squared, on the junction current in superconducting point junctions as well as in variable-width bridge junctions is examined. Measurements were made over wide ranges of critical current ($1-10^4$ μA) and normal resistance (0.05-100Ω). A correlational amplifier was used with transistors connected in parallel in the preamplifiers for matching the low resistance (10Ω) of point junctions and with transformers cooled to 4.2 K for matching the low resistance (0.1Ω) of bridge junctions. The noise was measured at 1 and 10 kHz as well as over the 0.15-20 kHz band. Shot noise was found to increase linearly with the junction current, and to exceed thermal noise above the critical current in point junctions but not in bridge junctions. Also a finer structure in the current spectrum of low-frequency noise was revealed, namely additional peaks at lower junction currents, which is theoretically explained on the basis of the resistive model of an autonomous Josephson junction with the tails of wideband Josephson generation extending into the pass band of the amplifier. This effect compounds the effect of changes in the differential junction resistance and the effect of step-down frequency conversion by mixing with the applied microwave signal. The authors thank V. P. DYAKOV for helping in the experiments with superconducting point junctions, V. P. KOSHELETS and G. A. OVSYANNIKOV for preparing the variable-width bridges and helping in the experiments with them. Figures 3; references 5: 2 Russian, 3 Western.
[189-2415]

ELECTRICAL ENGINEERING EQUIPMENT AND MACHINERY: APPLICATIONS AND THEORY

UDC 621.3.013.5:(621.313.28+621.313.291)001.24

SCATTERING FIELD IN A CYLINDRICAL SLOT OF AN AXISYMMETRIC EXCITATION SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 1, Jan/Feb 80 pp 119-129 manuscript received 24 Jan 79

ALIYEVSKIY, B. L. and SHERTSYUK, A. G., Moscow

[Abstract] An analysis is made of the scattering field in a cylindrical cavity containing a stationary magnetic field source with azimuthal component of the current density vector functionally distributed in space. Boundary conditions for the region of solution of the problem are assigned or experimentally determined. The initial equation for the azimuthal component of the vector potential of the plane-meridional magnetic field and the boundary conditions are given in dimensionless form, and the method of finite integral transforms is used to find the solution. The theoretical results are verified on physical models of a magnetic system with unipolar magnetization. It is shown that the problem solved on the basis of field theory equations gives a better idea of the topography of the lines of force than does the solution based on the method of probable magnetic flux paths. Figures 4; tables 2; references 16 Russian.
[177-6610]

UDC [621.311.25:621.039]:621.651/.68.001.4

RESULTS OF TESTS OF CIRCULATION PUMPS IN NUCLEAR ELECTRIC PLANTS WITH RBMK-1000 REACTORS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 11-14

PANAS, S. I., engineer, Yuzhtekhenergo

[Abstract] The results are given of tests of three OPV-145E (VM-5) circulation pumps in the water supply systems at the Kura and Chernobyl'sk nuclear electric plants. These pumps have a delivery rate of 10.0 m^3/s, a pressure head of 70.6 kPa, minimum hydrostatic head of 1.5 m, and efficiency of 82 percent. The drive is an AV17-31-16K motor with power of 1000 kW, speed of 365 rpm, voltage of 6000 V and efficiency of 93 percent. The operational tests show that the pumps meet design specifications. The hydraulic drag of the suction elbow makes up about a third of the losses that determine pump efficiency. Drag in this section amounts to 3.6-7.2 kPa within a delivery range of 8.0-11.5 m^3/s. Figures 6.
[176-6610]

UDC 621.313.13:537.228.1(088.8)

A PIEZOELECTRIC LINEAR VIBRATION MOTOR

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 2, Feb 80 pp 205-207
manuscript received 2 Apr 79

TROFIMOV, ADOL'F IVANOVICH, candidate of technical sciences, Dotsent, Tomsk Polytechnical Institute and YEVMENKO, VALERIY VLADIMIROVICH, engineer, Tomsk Polytechnical Institute

[Abstract] Piezoelectric motors are being developed which operate on the principle of converting high-frequency mechanical vibration of the stator to linear motion of the piston. Their outstanding features are simple construction, small size and high efficiency. In one variant the piezoelectric stator plate is pivoted in place at one end and at the other end pressed by a spring against the p[illegible]late made of a hard material (steel) moving on rollers. Here the a[illegible] thrust force depends on the amplitude of the excitation voltage as well as on the width and the number of piezoelectric plate layers. It is relatively small, inasmuch as excessive heating limits the maximum permissible voltage amplitude and noise with attendant inefficiency limit the maximum width of the piezoelectric plate. In another variant the piezoelectric plate moves between two rows of stationary steel

bearing plates pressed against it obliquely at one end and hinged to the housing at the other end. The piezoelectric piston plate can move only in one direction, "with" the slant of the bearing plates, but the direction can be reversed by reversing the direction of this slant. The slant or contact angle without spring loading corresponds to the friction coefficient for a piezoceramic-steel pair and the no-sliding threshold (16°), but can be made 45-50° for optimum motor performance characteristics by spring loading of the bearing plates. A prototype of the second variant has been built with a 100x30x12 mm^3 large TsTS-23 piezoceramic plate. It develops 6 kgf of thrust at a 65 percent efficiency, both the force and the speed of this motor depending linearly on the voltage amplitude. This motor is suitable for radio engineering and automatic control applications. Figures 2; references 4 Russian.
[187-2415]

UDC 621.313.333:621.316.726

FREQUENCY CONTROL OF A CONSTANT-POWER INDUCTION MOTOR ON THE BASIS OF MINIMUM CURRENT

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 2, Feb 80 pp 163-169 manuscript received 28 Jul 77; after completion 16 Apr 79

NOVIKOV, GEORGIY VLADIMIROVICH, candidate of technical sciences, Senior Scientific Research Worker, Moscow Power Engineering Institute

[Abstract] The speed of an induction motor is most efficiently and economically controlled on the basis of minimum stator current, namely by adjusting the voltage so as to minimize the current and thus also the heating at a given load level. Here, assuming no saturation of the magnetic circuit, the motor characteristics are calculated from the equivalent-circuit parameters: resistances and reactances. The expression for the motor slip is the same for constant-torque and constant-power operation. The power factor and the overload factor at constant power depend on the stator frequency. All performance characteristics, also including the torque, are shown as functions of the stator frequency and as functions of the stator voltage for constant-power operation at the minimum stator current. Frequency control is found to be nearly optimal when the stator frequency does not exceed double the nominal one. Figures 2; tables 1; references 7 Russian.
[187-2415]

UDC [621.313.333.2+621.313.323]-181.4.001.5

DESIGNING A STANDARD SERIES OF CONTROLLED INDUCTION MOTORS AND SYNCHRONOUS RELUCTANCE MOTORS

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 14-17 manuscript received 29 Jan 79

ALYMKULOV, K. A., candidate in technical sciences, MEGERA, V. M., engineer, KAASIK, P. YU., doctor of technical sciences, PUKHOV, A. A. and BORISOV, A. P., engineers

[Abstract] Some equipment for industrial automation requires a large number of servomotors with a very low power rating, below 1 W, to operate at 50 Hz. A standard series of such micropower motors has been designed which covers induction motors with a control phase and synchronous reluctance motors. Both types have been designed as fourpole machines, using the same stator laminations, with a 0.07-0.09 mm wide air gap in the "through" construction. The series is designed to conventional performance requirements: starting and running characteristics, electromechanical time constant for induction motors, pull-in time for synchronous motors, and maximum economy of materials. The stator diameter is selected on the basis of heating considerations. Subsequent design calculations follow the parametric method of synthesis, using the basic relations between motor parameters, equivalent-circuit parameters and physical dimensions. The main-flux magnetizing reactance at the fundamental frequency and with a nominal gap width disregarding the fringe effect due to slots serves as the reference parameter. Calculations and prototype tests indicate that, in order to ensure a satisfactory starting performance of a synchronous motor, it is necessary to rate it one power level lower than an induction motor of the same size. The overall performance indicators of this series are comparable with those of the best foreign-made equivalents. Tables 3; references 5 Russian.
[167-2415]

UDC 621.313.322-81

THE TVV-1000-4 TURBOGENERATOR WITH HYDROGEN-WATER COOLING

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 2-10

KHUTORETSKIY, G. M., doctor of technical sciences, and TROFIMOV, A. M., engineer, LPEO "Elektrosila" (Leningrad Electric Machine-Building Production Association "Elektrosila")

[Abstract] The TVV-1000-4 four-pole turbogenerator with power of a million kW is now being manufactured at the Leningrad "Elektrosila" Production Association. This unit is designed for operation in nuclear electric plants with a turbine that turns at 1500 rpm. The first generator is being made for installation at the South Ukrainian Nuclear Electric Plant. The TVV-1000-4 has the following characteristics: stator voltage 24,000 V, stator current 26,730 V, power factor 0.9, rotor current 7,560 A, efficiency 98.9 percent, hydrogen pressure inside the generator 5 kgf/cm^2. The design is similar to the TVV-800-2 800,000 kW turbogenerator now in series production. Construction details are given. Figures 11; tables 1; references 2 Russian. [176-6610]

UDC 621.313.322-81.001.24

EXPERIENCE WITH THE USE OF BANDING RINGS MADE OF TITANIUM IN TURBOGENERATORS

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 50-53 manuscript received 29 Feb 79

ZAGORODNAYA, G. A., candidate of technical sciences, KHUTORETSKIY, G. M., doctor of technical sciences, and ARKOVENKO, G. I., candidate of technical sciences

[Abstract] The banding of the turbogenerator rotor is a most critical item which affects the reliability of the entire machine. Traditionally nonmagnetic steel rings have been used for banding, but titanium alloys offer the advantages of lighter weight and thus lower stresses caused by centrifugal forces, as well as a higher resistance to corrosion. In the standard construction, banding rings at both ends of the rotor are shrunk on with interference fits by preheating, on the one end directly and on the other end on top of a centering ring not connected to the shaft and with additional fastening to prevent axial slippage. A comparative evaluation of both types of materials for banding rings indicates that titanium alloys can be just as

effective, if the interference fits are correspondingly larger. This would require shrink temperatures beyond the safe limit for the insulation underneath. The shrink temperature can be lowered, however, by either using steel inserts or more effectively by resorting to a flexible construction. Here the banding consists of three components: a thick base ring, a thinner shrink ring, and a thin flexible ring with wedges. Such a banding was installed in a 200 MW turbogenerator and evaluated after 11,000 h of operation at speeds not higher than 4200 rpm. Figures 4; tables 2; references 7 Russian.
[167-2415]

UDC 621.3.019.3:621.314.212.001.14

PROBLEMS OF ESTIMATING AND ENSURING THE RELIABILITY OF POWER TRANSFORMERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 1, Jan/Feb 80 pp 19-25 manuscript received 28 May 79

SOKOLOV, V. V. and LUKASHCHUK, V. A., Zaporozh'ye

[Abstract] Studies have shown that the reliability of present-day transformers in many cases is lower than that of transformers produced 20-30 years ago. This situation has made it necessary to improve methods of quantitative evaluation of reliability of transformers. For a number of reasons, power transformers are not tested for reliability, and efforts to improve reliability can be judged only from operational results. CIGRE group 15-05 has proposed a method of evaluating transformer reliability in which the indices are determined as the averages over a set period, and specifically the failure rate is given as $FR_m=n/NT$, where n is the number of failed transformers, N is the number of installed transformers, and T is the period of observation. Because the average service life of power transformers is 20-30 years, the recommended observation period is 2-3 years, which is convenient for comparative analysis, but is not suitable for predicting time between failures, setting guarantees and so on. Because of their high reliability and long service life, conventional methods of data processing by the methods of probability theory and mathematical statistics are not applicable to power transformers. This paper gives the results of analysis of the reliability level of transformers by using unconventional methods of statistical data processing. Causes of transformer failures are classified. It is found that power transformer failures conform to Weibull distribution with population parameters ranging from 0.3 to 0.75. Improvement of production shows up in an approach to exponential distribution. Figures 4; references 6: 5 Russian, 1 Western.
[177-6610]

UDC 621.313.334:654.94 .001.4

SMALL ROTATING TRANSFORMERS AND SELSYNS

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 20-23 manuscript received 21 Jun 79

KHRUSHCHEV, V. V., candidate of technical sciences, and KOVALEV, S. V., engineer

[Abstract] New series VT-5 and MVT-2 of small rotating transformers have been developed which feature concentric windings with sinusoidally distributed numbers of turns, an optimized tooth geometry, a special surface finish on both sides of the air gap, and combinations of materials with similar coefficients of thermal expansion (such as 79 NM Permalloy for the stator core and titanium for the housing). Also a new series of small Selsyns has been developed which includes the VS-151A receiver-indicator, the VS-155A receiver-transformer, and the VS-160A transmitter-indicator for operation at 400-500 Hz. Here a high accuracy is made possible, despite the fact that a smaller size means a higher winding resistance and thus a larger error, by incorporation of intermediate transformers with toroidal windings in quadrature and semiconductor amplifier components in the control winding circuit. The new construction of rotating transformers and Selsyns is also mechanically sturdy, less sensitive to climatic influencing factors, and ensures a high reliability. All these characteristics have been achieved by maximum control of manufacturing parameters, especially those causing an electromagnetic asymmetry, and by computer-aided selection of optimum geometrical design variants rather than experimental evaluation. Tables 2; references 3 Russian.
[167-2415]

UDC 621.314.222.6.001.57

FULL-SCALE MODELS FOR STUDYING THE ELECTRODYNAMIC DURABILITY OF LARGE TRANSFORMERS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 44-49

KONOV, YU. S., and KHUBLAROV, N. N., candidates of technical sciences, Scientific Research Center on Testing High-Voltage Equipment

[Abstract] A model is proposed that completely reproduces one of the windings of a large transformer with the test power considerably reduced by bringing the windings closer together in the radial direction. The radial forces in the model windings are about equal to those in the original

transformer. This model is used to study the radial stability of compressed transformer windings with consideration of all major factors. While radial forces are nearly independent of the radial structure of the windings, the axial forces are approximately proportional to the testing power. This is compensated by increasing the height of the field winding. Most transformers and autotransformers with three-phase power of less than 500 MVA can be tested on the full-scale model without additional steps to reduce the testing power. With certain modifications, the model can be adapted for testing transformers up to 1000 MVA. Figures 3; tables 3; references 7: 6 Russian, 1 Western.
[176-6610]

UDC 621.331.5:621.335.2-833

ELECTRICAL EQUIPMENT FOR ELECTRIC TRACTION DRIVES IN NEW DIESEL LOCOMOTIVES

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 44-48 manuscript received 7 Dec 78

OZERNOY, N. F. and VERKHOGLYAD, V. YE., engineers; MIKHNEVICH, G. A. and BLOSHENKO, I. YA., candidates of technical sciences

[Abstract] New standard traction motors with electrical controls and regulators for modern autonomous Diesel locomotives have been developed in order to meet the demand for higher power capability and higher reliability without appreciable size and weight increases. The automatic control system is now an integrated one, including the KUA-10 thyristor converter, the KUA-13 generator voltage regulator and the KUA-14 brake regulator. The appurtenances include miniature 500 A and 1250 A contactors as well as interference-immune d.c. instrument transformers, controllers, and tape-wound resistors. Most significant improvements have been made in the design of the traction motors. They are now more precisely manufactured and feature thin class F,H insulation of the windings along with better ventilation, which increases their load capacity. The optimum rating was found to be 667 kW at 1000 V, with a 66.7% voltage regulation, and a maximum current of 1000 A. Commutation is improved by optimization of the interpole geometry, by use of a lap winding in the armature with only a few conductors per slot, and by minimization of the slot permeance. Split brushes on a carbon-powder base allow for a current density of 15 A/cm^2 and black-band commutation over a 1.5 range in continuous duty. Mechanical improvements include a more rigid shaft, a better layout of coil extensions and connections, and a dynamically more reliable cradle mounting of the motor. An important aspect of an independent electric power supply in individual Diesel locomotives is the necessity, and the possibility, of tailoring the main a.c. system to the special requirements of this application. References 5: 3 Russian, 2 Western.
[167-2415]

UDC 530.1

FIELD OF A POINT SOURCE IN ONE-DIMENSIONAL RANDOMLY INHOMOGENEOUS MEDIUM WITH MIRROR REFLECTING WALL

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1408-1410 manuscript received 17 May 77; after revision 6 Jun 79

POGREBNYAK, V. A., Institute of Radiophysics and Electronics, Ukrainian Academy of Sciences

[Abstract] Calculation of repeated scattering in problems of propagation of plane waves in one-dimensional randomly non-homogeneous media produces results which are very different from those derived in the theory of transfer. Statistical characteristics of the field have been studied where the wave source is located inside the medium. The case is now considered where the source is situated in a layer having a mirror reflective wall. Despite the fact that the one-dimensional problem has been rather fully studied, the selection of a particular model makes it possible to obtain more detailed information on the process of repeated scattering. The reflective ability of the randomly non-homogeneous plate increases geometrically in direct proportion to plate thickness. The interface of media for any plate thickness makes a contribution proportional to ε_0. The author thanks I. M. FUKS for a suggestion concerned with the problem and for helpful discussions. References 8: 6 Russian, 2 Western.
[127-8617]

UDC 530.1

MULTIPOLE EXPANSION OF ELECTRIC-TYPE SOURCE FIELD IN A CONDUCTING MEDIUM

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1343-1355 manuscript received 22 Dec 78

BORISOV, V. V., Leningrad State University

[Abstract] One method for solving electrodynamic problems in a non-periodic relationship of components of the electromagnetic field as a function of time is the incomplete separation of variables with subsequent solution of an equation which depends on time and one spatial variable using the Riemann method. This method is particularly successful in analyzing the electromagnetic field of sources in free space. The end result is a multipole expansion of field components. A multipole expansion of the field of an electric-type source is constructed for a conductive medium with azimuthal symmetry. References 9: 7 Russian, 2 Western (1 translated).
[127-8617]

UDC 533.951

RESONANCE EFFECTS IN A PLASMA WITH HELICAL STRUCTURE (SHEAR) OF THE MAGNETIC FIELD

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 133-142 manuscript received 28 Feb 79

BELLYUSTIN, N. S., Scientific Research Radiophysics Institute

[Abstract] Propagation in a plasma with uniform shear is investigated and main attention is given to the effects of linear transformation of waves which are resonant in nature, i.e., they are manifested only under specific conditions of synchronism between the wave vectors of interacting waves and the helix of an external magnetic field. This is a new example of parametric interaction of waves on period structures. These phenomena play a role in different applications. The helical structure of the magnetic field can be related to a low-frequency wave propagated along the magnetic field in a homogeneous plasma. These effects are of interest both for space and laboratory plasma applications. In a real plasma the effects are distorted by absorption of the medium, spatial dispersion and inhomogeneity, which requires additional consideration of these factors. Appropriate equations are derived to show the physical applications. Figures 4; references 3: 2 Russian, 1 Western.
[191-6521]

UDC 534.222.232

RADIATION OF A VERTICAL ELECTRIC DIPOLE LOCATED ON THE AXIS OF AN IDEALLY CONDUCTIVE DISK

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 101-112 manuscript received 22 Jan 79; after completion 13 Aug 79

PIMENOV, YU. V. and DAVYDOV, A. G., Moscow Electrical Engineering Institute of Communications

[Abstract] The axisymmetric problem of the effect that an ideally conductive disk has on the radiation of a vertical electric dipole has been rigorously solved for disk dimensions that are large compared with a wavelength. However, numerical calculations are difficult because the series of the solutions converge extremely slowly. Therefore an asymptotic solution is needed for the case $\gamma = ka>>1$, where a is the radius of the disk, $k = 2\pi/\lambda$ is the wave number, λ is wavelength. The problem is simplified by using the principle of duality in which an auxiliary problem is first considered on radiation of a vertical magnetic dipole located on the axis of an opening in an ideally conductive plane, after which known formulas are used to convert to the initial problem. This approach has previously been applied to radiation of an elementary electric dipole situated in the center of an ideally conductive disk at a right angle to the plane of the disk. In a previous paper the authors considered the auxiliary problem for arbitrary elevation of an elementary magnetic dipole above the plane of a screen [see "Radiotekhnika," Vol 33, No 7, 1978, p 91]. A strict Fredholm's equation of the first kind was set up for the density of currents induced on the plane with a circular opening, and an asymptotic solution was found. In this paper, the authors now continue their analysis and derive formulas that are convenient for calculations when $\gamma>>1$ for the electromagnetic field in the case of the auxiliary problem, and also make the transition to the initial problem. These formulas can be used to analyze the structure of the electromagnetic field not only in the far zone, but throughout all space. The results of numerical calculations are compared with exact results, and it is shown that the structure of the electromagnetic field is described quite well even when $\gamma = 5$. Figures 7; references 8: 6 Russian, 2 Western.
[155-6610]

UDC 537.874.2

SCATTERING OF PLANE ELECTROMAGNETIC WAVES BY A RADIALLY CONDUCTING CONICAL REFLECTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 232-240 manuscript received 22 Jan 79

GOSHIN, G. G., KRAVCHENKO, G. G. and MYSHKIN, V. G.

[Abstract] Biconical structures are used as broadband vibrators for antennas and as reference standards of effective scattering cross section for radar. Here a biconical reflector is considered whose lateral surfaces have been formed by a bundle of radial conductors with a low aerodynamic drag. The problem of scattering by this reflector is formulated in terms of the homogeneous Helmholtz equation for potentials and current densities induced by a plane incident wave, with appropriate boundary conditions. The sought potentials are expanded into Fourier series with Kontorovich-Lebedev integrals as coefficients, which lead to a system of functional equations consisting of two independent generalized Wiener-Hopf equations. The latter are reduced to infinite-order systems of linear algebraic equations solvable with any desired accuracy and degenerating into a single equation for the extreme case of a $\theta_0 = \frac{1}{2}\pi$ aperture half-angle. Application of the residue theorem to the coefficients-integrals of the Fourier series transforms the latter to series, with which now the components of the scattered field can be found. Scattering patterns of a thin biconical vibrator with an acute aperture angle have been computed for the case of normal wave incidence and linear field polarization (E or H). Figures 4; references 6: 5 Russian, 1 Western.
[189-2415]

UDC 537.874.4

CAUSALITY FORMULATION OF THE PROBLEM OF BACKSCATTERING FROM A LAYER OF A RANDOMLY NONHOMOGENEOUS MEDIUM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 269-279 manuscript received 20 Oct 78

SAICHEV, A. I.

[Abstract] From the solutions to the Helmholtz stochastic equation which satisfy the causality principle and the appropriate boundary conditions, an integral equation is derived for a wave reflected from a layer of a randomly nonhomogeneous medium. This equation can easily be solved for a

plane-parallel layer and can be further simplified when the nonhomogeneity scale is larger than the wavelength. Here it is solved in the approximation of a single backscattering from a medium with large-scale inhomogeneities. The author thanks A. N. MALAKHOV for the interest in this study. References 10: 8 Russian, 2 Western.
[189-2415]

UDC 538.56:539.12

CHERENKOV EMISSION OF ACOUSTIC GRAVITATIONAL WAVES BY HORIZONTALLY MOVING SOURCES

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 159-168
manuscript received 11 Mar 79

LIPOVSKIY, V. D., Leningrad State University

[Abstract] Classification of types of radiation, determination of kinematic conditions and calculation of radiation intensity are investigated. Calculation of radiation intensity is of interest in postulating the problem of electromagnetic wave scattering in ionospheric inhomogeneities created by moving acoustic gravitational wave sources. Cherenkov radiation in anisotropic media contains spectral-angular regions with negative group velocity. Projections of the wave vector and group velocity perpendicular to the direction of motion have different signs. Kinematic equations are derived to calculate the intensity distribution of transverse wave numbers by frequency and angle in space for an arbitrary mass source. Supersonic motion of a guass-distributed source is used as an example. References 14: 10 Russian, 4 Western.
[191-6521]

UDC 538.574.5:539.293

CROSS MODULATION OF ELECTROMAGNETIC WAVES IN SEMICONDUCTORS WITH A SUPER LATTICE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 232-237 manuscript received 9 Feb 79

ORLOV, L. K. and ROMANOV, YU. A., Scientific Research Physicotechnical Institute Attached to Gor'kiy University

[Abstract] The propagation is considered of a weak electromagnetic wave in a super lattice exposed to a strong high-frequency pumping field modulated in amplitude. Cross modulation of the electromagnetic waves, which has been thoroughly studied in the radio band for an ionospheric plasma, occurs. The characteristic effect in a super lattice is that a signal can be considerably amplified and can have a greater percentage modulation caused by negative high-frequency conductivity than that of the pumping field. The shape of the signal envelope varies upon variation of the pumping field parameters and modulation of the field. The processes can be used for modulation and detection of a high-frequency signal with simultaneous amplification of it and also to obtain short pulses. The results can also be used to analyze the effect of low-frequency noise on signal characteristics. The authors are deeply appreciative to A. M. Belyantsev and V. N. Shabanov for a number of valuable comments. Figures 4; references 5 Russian.
[191-6521]

UDC 539.19:621.3.029.6:537.226.2

INTERNAL ENERGY OF A MOLECULE OF A POLAR MEDIUM IN RELATION TO THE MICROWAVE FIELD INTENSITY AND THE COMPLEX DIELECTRIC PERMITTIVITY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 352-365 manuscript received 21 Mar 77

GAYDUK, V. I. and TSEYTLIN, B. M.

[Abstract] Passage of electromagnetic waves through a polar medium is characterized by complex dielectric permittivity. The resulting change of internal energy of charges or molecules depends on the field frequency and intensity as well as on the properties of the medium. Available data on the change of internal energy are inconsistent and consequently a law of dipole motion and a dependence of this change of internal energy on the complex dielectric permittivity are established in the paper. The analysis is based

on the equation of motion for a one-dimensional rotator in a linear medium interacting with a linearly polarized microwave radiation field, and on the interaction model where collisions between particles attenuate the radiation. Spatial dispersion is disregarded because of the dimension of molecular dipole is much smaller than the wavelength, and the medium is assumed to remain at a constant temperature with all heat caused by interaction dissipated. The equations of motion are integrated exactly for the oscillators and only in a weak-field approximation for the rotators. After the change of internal energy and the dielectric susceptibility of a classical assembly of colliding oscillators have been calculated accordingly, an assembly of rigid molecular rotators is considered in general as well as with a Boltzmann distribution or with a monoenergetic distribution. When the distribution of particles with respect to lifetime is exponential, then the change of internal energy is proportional to the complex dielectric susceptibility. During thermodynamic equilibrium, moreover, the absorption curve is narrow for oscillators but wider than the Boltzmann frequency for rotators. An assembly of rotators in a weak microwave field behaves according to the Landau absorption phenomenon. Figures 5; references 17: 9 Russian, 8 Western (in translation). [189-2415]

UDC 550.388.2

THE STABILITY OF MEAN LATITUDE IONOSPHERIC PLASMA CONTAINING PHOTOELECTRONS

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 143-150
manuscript received 29 Jan 79

IVANOV, V. B., TRUKHAN, A. A. and KHAZANOV, G. V., Irkutsk State University

[Abstract] The stability of natural potential oscillations of a plasma whose existence is possible in a mean latitude ionosphere is analyzed. The ionospheric plasma and the geomagnetic field are assumed homogeneous. The investigation for stability was carried out for the lower part of the F-region of the ionosphere. The electron distribution function in the daytime ionosphere is formed by collision mechanisms and by ultraviolet radiation from the sun. This results in a number of peaks caused by the resonance structure of ion formation processes in the distribution function and there is a minimum in the region of 2.2-4 eV related to effective energy losses of photoelectrons to excitation of the vibrational levels of molecular nitrogen. Numerical calculations of the increments of instability of various type showed that oscillations with a frequency close to the upper hybrid frequency with small finite values of the wave propagated at an angle close to $\pi/2$ with respect to the geomagnetic lines of force are closest to the critical state. The

proximity of the increment of instability to the collision detriment should lead to formation of an increased level of plasma noise in an ionospheric plasma. Since the typical time of collision relaxation of the distribution function becomes comparable to the time of particle interaction with waves, one may expect that wave-particle interaction may be reflected in formation of the photoelectron distribution function itself. Figures 1; references 13: 9 Russian, 4 Western.
[191-6521]

UDC 621.3

APPROACH TO INVESTIGATION OF DIFFRACTION PROBLEMS IN NONHOMOGENEOUS MEDIA

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 103-104
manuscript received 29 Mar 79

KULIKOV, S. P. and SAMOKHIN, A. B.

[Abstract] The authors considers a rigorous approach to exact solution of wave equations for electromagnetic fields in inhomogeneous media based on known solutions of the corresponding equations with a constant coefficient ε. The technique involves artificial formation of an inhomogeneous term in these equations, and is illustrated by the specific example of rigorous solution of a diffraction problem in a medium that is inhomogeneous with respect to two coordinates. It is shown that the proposed method can be used to get media with predetermined properties, and in particular with "blackbody" properties. References 1 Russian.
[185-6610]

ELECTRON TUBES; ELECTROVACUUM TECHNOLOGY

UDC 621.385.6

RESONANT INTERACTION IN A CYLINDRICAL MAGNETRON

or'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 113-121
manuscript received 4 Dec 78, after consolidation 5 Jun 79

KRASNIKOV, M. YU., Gor'kiy State University

[Abstract] The method of averaging is used to study the motion of electrons in a cylindrical magnetron in the cyclotron resonance mode, where interaction changes the radii of the electron orbits. An examination is made of the influence that cylindrical shape has on the nature of resonant interaction in the magnetron, and theory is compared with experimental data. It is shown that many experimental facts relating to weak-field and surface-wave magnetrons can be attributed to cyclotron resonance. Figures 6; tables 1; references 12: 8 Russian, 4 Western.
[155-6610]

UDC 621.385.6

CONSIDERATION OF THE NATURAL MAGNETIC FIELD OF A BEAM IN NONLINEAR TRAVELING-WAVE TUBE THEORY

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 219-222
manuscript received 5 Jan 79

ROMASHIN, N. L. and SOLNTSEV, V. A., Moscow Institute of Electronic Machine Building

[Abstract] The natural magnetic field of rotating beams in nonlinear traveling-wave tube theory and specifically in the program of two-dimensional calculation of devices is considered. An expression for the components of circular fields with single current in the waveguide, which is essentially a magnetic Green function, was found for calculating quasi-static magnetic fields of the beam. The retarding system was replaced by a smooth waveguide, as

when calculating quasi-static electric fields, because conductivity was regarded as infinite. This substitution can also be made at relativistic electron velocities because retardation is low, the retarding system is almost smooth and dynamic corrections to the space charge field caused by the retarding system should have no appreciable effect. Figures 1; references 6 Russian.
[191-6521]

UDC 621.385.623.2

THEORY OF THE TRANSITION PROCESS IN A HIGH-Q RELATIVISTIC MONOTRONE OF A TRAVELING WAVE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23 No 2, 1980 pp 223-231
manuscript received 30 Jan 79

TRUBETSKOV, D. I. and CHETVERIKOV, A. P., Saratov State University

[Abstract] The high-Q relativistic monotrone of a traveling wave is investigated. This monotrone is regarded as a promising relativistic SHF generator in the shortwave region of the SHF band due to its simple design. The transition process in the relativistic monotrone of a traveling wave is analyzed in the case of electron beam interaction only with a single type of resonator oscillations, assuming that the beam current is somewhat higher than the starting value for the given type of oscillations and is below the starting values for the remaining types of oscillations. The given concepts are applicable for the case of excitation of more than two types of oscillations if conditions that one type of oscillation has a prevalent amplitude at the beginning of the nonlinear stage of the transition process. In this case the effect of the remaining types of weak oscillations on establishment of strong oscillations can be disregarded. Figures 4; references 7 Russian; 1 Western (translated).
[191-6521]

INSTRUMENTS, MEASURING DEVICES AND TESTERS; METHODS OF MEASURING; GENERAL EXPERIMENTAL TECHNIQUES

UDC 533.951.7

INTERACTION OF A WAVE PACKET WITH RANDOM NOISE IN THE BURGERS EQUATION

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 68-78 manuscript received 10 Oct 78; after completion, 24 Jul 79

MOISEYEV, S. S., TUR, A. V. and YANOVSKIY, V. V.

[Abstract] An examination is made of the interaction of an arbitrary deterministic component of a wave packet with a random background within the framework of the Burgers equation. A method is proposed that gives an equation that exactly describes the evolution of the deterministic component under conditions of strong coupling. Explicit analytical expressions are obtained for an arbitrary deterministic signal. It is shown that attenuation is due to the development of turbulent viscosity, which is exactly calculated. The authors thank B. B. Kadomtsev for discussion and constructive criticism. References 11 Russian.
[155-6610]

UDC 537.8:621.3.029.65

EXPERIMENTAL STUDY OF NEAR ELECTROMAGNETIC FIELDS IN THE MILLIMETER-WAVE BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 225-231 manuscript received 26 Dec 78

ANDRENKO, S. D., PROVALOV, S. A. and SHESTOPALOV, V. P.

[Abstract] The amplitude-phase distribution of near fields in the millimeter-wave band was studied experimentally by the method of resistive probing, with necessary departures from the classical microwave techniques in the reference channel and adaptations to the corresponding frequency range. The instrumentation included a klystron oscillator, a dielectric waveguide, a reference-channel diffraction grid of the reflection type with a rectangular cross section and with a space period of 2.78 mm for the wavelength λ= 4.20 mm, a matched load, a probe with a decoupler and a comparator, also two

horn antennas. With this apparatus were mapped the near fields, in the form of isophase lines and isoamplitude lines, of a bar diffraction grating with a rectangular cross section and also of a tape diffraction grating. A comparison with a theoretical analysis of near field produced by surface waves reveals a similarity between calculated and measured topologies. Figures 7; references 4 Russian.
[189-2415]

UDC 539.2.01

AMPLIFICATION AND MODULATION OF QUADRUPOLE SPIN ECHO IN TWO-FREQUENCY ACTION

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1403-1405 manuscript received 2 Jan 79

AYNBINDER, N. YE., AZHEGANOV, A. S. and KIM, A. S., Perm State University

[Abstract] A program was used in which the excitation pulse in the junction next to the test junction is fed directly before a probing pulse. This leads to an increase of the signal amplitude of the spin echo and modulation of the echo signal envelope. Figures 3; references 9: 6 Russian, 3 Western.
[127-8617]

UDC 62-503.32

SIMPLIFIED INSTRUMENTAL DETERMINATION OF THE TIME SHIFT BETWEEN TWO RANDOM PROCESSES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 68-70 manuscript received 10 May 78; after revision 27 Mar 79

VOLKOV, I. I., SEMENYCHEV, V. K. and TOKAREV, A. P.

[Abstract] A simple instrument for determining the time shift between two stationary or stationarily coupled random processes is shown which includes two filters with the respective pulse response characteristics $h_1(\tau) = \frac{2}{T}\frac{1}{T}e^{-\tau/T}$ and $h_2(\tau) = \frac{2}{T}e^{-\tau/T}$, a filter with the pulse response characteristic $h_3(\tau) = \delta(\tau) - h_2(\tau)$, a subtractor, a linear converter multiplying the input signal by an adjustable conversion factor, a circuit controlling this conversion factor, an adder, an inverter, a multiplier module, and an averaging

circuit with a given time constant which yields the mathematical expectation of the product of the two signals. The operation of this instrument is analyzed on the basis of a first-order differential equation for the conversion factor with respect to time. Fluctuations are, moreover, assumed to occur at the output of the averaging circuit and the mathematical expectation of the time shift between the two signals is obtained after the necessary integrations have been performed. Figures 1; references 2 Russian.
[174-2415]

UDC 621.313-181.4.013:621.317.42

A NEW METHOD AND DEVICE FOR ANALYZING THE MAGNETIC FIELD IN ELECTRICAL MICROMACHINES

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 37-38

BLOK, HENRYK, master of science, DUDZIKOWSKI, IGNACY, doctor of technical sciences, and SCHOEPP, KONRAD, doctor of technical sciences, People's Republic of Poland

[Abstract] A contactless method of analyzing the magnetic field and measuring its distribution in the air gap of electrical machines has been developed which is quite universal, though specifically aimed at small machines with an outside stator diameter up to 150 mm. The device for this purpose consists of a mechanical drive and a Hall probe with electronic circuitry including an oscillograph. The gist of the novelty is a fixed placement of the Hall probe in the air gap with the possibility of rotating not only the rotor but also the stator in a fixture and of regulating the speed of each independently. The oscillograms record the magnetic field around the air gap, together with the slot ripple and the effect of armature reaction. Any load level can be simulated here, from idle run to stall (short circuit). The equipment includes a stabilized voltage supply, a current (d.c.) stabilizer, a 1 kHz oscillator, a preamplifier, a voltage amplifier, a phase-sensitive modulator, and an output power amplifier, also a milliammeter and a millivoltmeter. The device can measure magnetic induction from 0.01 to 1.5 T at frequencies from 0 to 1000 Hz. It can measure permanent, alternating and rotating magnetic fields with any Hall probe, not requiring calibration, the output signal being always proportional to the magnetic induction measured. Figures 4; tables 1; references 3 Polish.
[167-2415]

UDC 621.319.4.019

CALCULATION OF THE ENERGY LOSSES IN A CAPACITOR UNDER A PULSE VOLTAGE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 85-87
manuscript received 22 Aug 78; after revision 27 Nov 78

MEZENIN, O. L.

[Abstract] The energy losses in a capacitor under a nonsinusoidal voltage pulse can be calculated by resolving the pulse into harmonic components, by replacing the pulse with an equivalent one, by using the transfer function of the capacitor, or by replacing the capacitor with active elements whose parameters are not frequency dependent. Here the energy losses are calculated on the basis of a physical model of a capacitor as an array of parallel RC relaxation circuits simulating the various processes in real dielectrics. This concept is applied to the specific case of a switching capacitor in a thyristor-type voltage converter which, typically, receives a series of n quasi-trapezoidal pulses with cosinusoidal leading and trailing edges. With the aid of the Duhamel integral and by subsequent integration and summation, the average power loss during the last pulse period is calculated (this also being the maximum power loss throughout the series) and two coefficients are established which characterize the energy loss in any one relaxation branch during the transient period and in the steady state respectively, the total power loss being proportional to their difference. Figures 2; references 7: 6 Russian, 1 German.
[174-2415]

MICROELECTRONICS

UDC 621.372.8

CALCULATING THE CAPACITANCE OF A GAP IN ASYMMETRIC STRIPLINE STRUCTURES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 97-98
manuscript received 30 Nov 78; after revision 5 Jun 79

PAVLOV, V. YA.

[Abstract] Asymmetric microstrips are becoming a major component in microwave integrated circuits. In calculating such microcircuits, consideration must be given to the parasitic effect of gaps, breaks, junctions and the like. Previous research on the influence of gaps in striplines has yielded results that are inconvenient for engineering practice. In this paper the author derives formulas for microstrip gap capacitance that combine simplicity with satisfactory accuracy. For comparatively wide gaps, the formula gives an accuracy within 7 percent, and a simplified version can be used for very narrow gaps that gives accuracy within 5 percent. Figures 2; references 2 Western.
[185-6610]

UDC 621.375.147.2

USE OF FUSIBLE GLASS AS BETWEEN-LAYER INSULATION IN SANDWICH MICROCHIPS

PRIBORY I SISTEMY UPRAVLENIYA in Russian No 2, 1980 pp 35-36

GUSEV, V. N., VESELOVA, V. G., SUKHACHEV, V. A., VOROB'YEVA, E. V. and SHUMILOVA, T. K., engineers

[Abstract] Tests were conducted in order to determine the feasibility of replacing the material of the bottom switching layer with aluminum, to determine the change of the specific resistance of the conductors of the bottom layer after the fusing of glass, to develop reliable connections between switching layers with a low junction resistance, and to find etching agents for photolithography. The tests were conducted on grade ST-50-1-1

sital substrate with a sputtered chromium-aluminum structure. The thickness of the aluminum layer was 1-1.8 micron. A glass layer was applied on the substrate by sedimentation from suspension and subsequent fusion in a muffle furnace for 7-10 minutes at 565 ± 5°C. Two fused layers of glass were applied by sedimentation to make a 14-16-micron thick insulation layer. Junction windows were etched in the dielectric film with ammonium persulfate solution through a photoresistive mask. Etching defects were healed in the glass and the sharp edges of the holes were smoothed off by refusing the glass. The substrates were processed with HF voltage prior to sputtering in order to remove the aluminum oxide film and scum formed by etching the glass at the contacts between the top and bottom layers, and to make between-layer junctions with low resistance. A second chromium-copper-vanadium conducting layer was sputtered on and junction windows were metallized. Then copper and nickel were electrochemically precipitated on the conductors and window walls through the mask. The heavy metal layer in the holes assures reliable contact between the switching layers. Active elements with welded aluminum leads can be made with a 1-micron thick nickel mask. Aluminum does not interact with the glass at 565° and the specific resistance of the conductors changes little after the glass is fused. An analysis of the insulation properties of glass on aluminum-glass-aluminum capacitor structures disclosed that the electrophysical parameters of the glass film are not altered. Ionic treatment for 5 minutes produces a low-resistance contact and satisfactory adhesion between the second switching film and the glass. The selective copper etching agent for use with a nickel mask is 150 g Cr_2O_3, 35 ml HNO_3, 10 ml HCl and up to 1 liter H_2O. The etching agent for chromium is a solution based on potassium ferricyanide, which does not damage the glass and protective mask. The described process produces 1-15-micron thick flawless glass layers of uniform thickness. Figures 3; tables 2; references 6: 5 Russian, 1 Western.
[-7872]

UDC 621.382.8

PREDICTING THE RELIABILITY OF METAL-OXIDE-SEMICONDUCTOR INTEGRATED-CIRCUIT SYSTEMS BY THE METHOD OF OPERATING REGIONS

Moscow MIKROELEKTRONIKA in Russian Vol 9 No 2, Mar/Apr 80 pp 114-120 manuscript received 25 Oct 78

ORNATSKIY, M. M. and POPOV, V. D.

[Abstract] Various designs of MOS-transistor logic in digital integrated-circuit systems can be compared with respect to reliability by the graphical method of operating regions. The performance characteristics are plotted as families of curves with the design limits as parameters, over the operating voltage range. In the case of inverters their main performance characteristics, interference immunity at the "0" output level and at the "1" level, are determined by the load resistance and the threshold control voltage. The quality index, the product of power drain by switching speed, is determined by the trend of the current curve. In these planes smaller regions corresponding to higher reliability are bounded by curves corresponding to lower values of the limiting parameter (maximum current). For illustration, this method is here applied to three kinds of inverters: loaded MOS transistor with induced channel, loaded MOS transistor with built-in channel, resistor with acceptor doping. The reliability or immunity to successive failures following successive changes in the parameters of an elementary stage can be predicted by this method, to an extent depending on the degree of circuit integration. Figures 5; references 9: 7 Russian, 2 Western.
[188-2415]

UDC 538.574:519.25

CONSIDERATION OF SOME CORRECTIONS TO PARABOLIC APPROXIMATION OF QUASI-OPTICS IN STATISTICAL DESCRIPTION OF WAVES PROPAGATING IN RANDOMLY INHOMOGENEOUS MEDIA

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1405-1408 manuscript received 1 Dec 78

SAICHEV, A. I., Gorky State University

[Abstract] Propagation of a wave in a randomly nonhomogeneous layer is described by a stochastic Helmholtz equation. If nonhomogeneities of the medium are large-scaled, and the wave striking the layer is quasi-plane, the precision stochastic Helmholtz equation is usually shifted to a simpler approximate parabolic equation of quasi-optics. However, the simple parabolic equation does not describe many physical effects, such as backscattering. There is a "dead zone" around the limits of applicability of the parabolic equation which must be filled by deriving approximate equations which are more general than the parabolic equation but are simpler than the stochastic Helmholtz equation. The author is grateful to A. N. Malakhov for attention to the work. References 2 Russian.
[127-8617]

OSCILLATORS, MODULATORS, GENERATORS

UDC 621.382.026.64

FLICKER NOISE OF MICROWAVE DETECTORS USING SCHOTTKY BARRIER DIODES

Gorky IZV. VUZ: RADIOFIZIKA in Russian No 11, Nov 79 pp 1392-1400 manuscript received 22 Mar 79

KRONILOV, S. A., LOSEV, V. L. and MESHCHERYAKOV, Leningrad Electrical Engineering Institute of Communications; Leningrad Polytechnic Institute

[Abstract] Microwave detectors using Schottky barrier diodes have increased fluctuation sensitivity as compared with p-n junction detectors. The factors determining the noise behavior of such detectors in the flicker region are explained. The experiment employed planar n-type Schottky barrier diodes made of GaAs. Low-frequency noise was measured under static conditions and detecting conditions. A theoretical model is developed, and the limits of its applicability are discussed. Figures 5; tables 1; references 6: 4 Russian, 2 Western.
[127-8617]

UDC 621.382.029.64

FREQUENCY PULLING IN A GUNN-EFFECT OSCILLATOR TUNED WITH A FERRITE SPHERE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 433-435 manuscript received 3 Jul 78

MARYNOV, B. A. and FADEYEV, A. O.

[Abstract] The possibility of frequency pulling in an oscillatory system with two degrees of freedom is demonstrated theoretically in the case of a Gunn-effect oscillator built on a microstripline and tuned with a ferrite sphere. The latter, magnetized to saturation, is located at the center of the coupling loop connecting the Gunn-effect diode to the load. The analysis is based on the equivalent circuit diagram, with the ferrite sphere shown as an RLC parallel combination with a resonance frequency and a bandwidth. Calculations thus involve a fourth-degree equation in two frequencies,

which can be treated in dimensionless form. Frequency pulling has also been confirmed experimentally with an AA703 diode and a semiannular stripline coupling it to a 50Ω coaxial load and with a tuning sphere made of yttrium ferrogarnet. Frequency pulling was found to occur within the 250-280 kA/m range of the magnetizing field intensity, the oscillator frequency being equal to either the higher or the lower natural frequency of the 2-stage circuit with a k= 0.2 coupling coefficient. The authors thank V. V. ROGOZIN for interest in this study. Figures 3; references 7 Russian.
[189-2415]

PHOTELECTRIC PHENOMENA AND DEVICES; ELECTROLUMINESCENCE; ION DEVICES

UDC 615.471:615.851.45

A PHOTOTACTILE CONVERTER ON THE BASIS OF SILICON PHOTORECEIVER AND PIEZOCERAMIC MATRICES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 82-84
manuscript received 3 Jul 78; after revision 27 Dec 78

MOCHALKINA, O. R. and STEPANOV, V. M.

[Abstract] Phototactile converters are used in reading machines for the blind. They convert visual configurations to tactile ones in two stages: photoelectric conversion of an optical image to a sequence of electric signals carrying information about the spatial distribution of luminous flux and then electromechanical conversion of these signals to a spatially distributed tactile image. The first conversion takes place in a silicon photoreceiver matrix consisting of 24x6 phototransistor cells arranged in 6 columns with their emitters connected into 24 rows, the columns isolated through p-n junctions. The second conversion takes place in a matrix of piezoelectric bimorph cells. These are 2-layer piezoceramic plates with metallized electrodes, connected in series or parallel, mounted rigidly at one end with proper flexure under an excitation voltage ensured by polarization of the layers. They are most sensitive to vibrations within the 200-600 Hz frequency range, regardless of their natural frequency, the threshold sensitivity being approximately 10 V and a much higher voltage being required for clear perception. To every repetition rate of excitation pulses there corresponds a definite range of pulse durations within which the threshold sensitivity is minimum. The necessary amplitude of excitation pulses is minimum at an off-duty factor within the 1.2-6.0 range. An experimental tactile matrix has been built and tested which, owing to the "staircase" mounting of bimorph cells, reproduces an image on a 28x12 mm^2 area equal to that of a human fingertip. The controlled commutator, which includes a cadence oscillator, six comparators with JK triggers, and a matrix of switching transistors, delivers excitation pulses with an amplitude of 30 V at a repetition rate of 300 Hz and a 2.0 off-duty factor. Figures 3; references 3: 1 Russian, 2 Western.
[174-2415]

POWER SYSTEMS; EFFECT OF VARIOUS ITEMS ON POWER TRANSMISSION LINES

UDC 621.315.1-752.2

DEVELOPING AND TESTING A NEW VIBRATION DAMPER FOR WIRES ON OVERHEAD TRANSMISSION LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 56-59

BONN, G. I., engineer, SAVVAITOV, D. S., candidate of technical sciences, LOVETSKAYA, YE. N., engineer, and KRYLOV, S. V., candidate of technical sciences, VNIIE-MO SKTB Tresta Elektroset'izolyatsiya (All-Union Scientific Research Institute of Electric Power Engineering, Moscow Regional Special Technological Design Office of Elektroset'izolyatsiya Trust)

[Abstract] The most widely used device for vibration reduction on overhead transmission lines is the Stockbridge damper, which operates on the principle of dissipating energy to internal friction between the strands of a cable when weights oscillate. There are two main areas of research in improving the effectiveness, simplifying the design and reducing the cost of vibration dampers for overhead transmission lines: 1) Development of dampers with an extended range of working frequencies in order to reduce the number of standard sizes; and 2) Updating Stockbridge dampers in order to improve the technological properties and stabilize the protective characteristics. This article describes the GVN-5-25Ye and GVN-5-30Ye dampers developed by the All-Union Institute of Electric Power Engineering and the Moscow Regional Special Technological Design Office of the Elektroset'izolyatsiya Trust. The design uses V-shaped weights that are made of cast iron and founded in place onto ready-made steel sleeves that are then fit onto the cable ends and pressed to make a permanent connection. This process reduces the cost of making the weights, and eliminates the influence of heat on the steel cable. These dampers have been tested in the laboratory for vibration resistance, and the frequency-energy responses have been plotted. The positive results of these studies were the basis for in situ tests of the new vibration dampers. The results of two series of three-week tests are given for an experimental overhead transmission line with vibrations exceeding the permissible peak-to-peak amplitude by a factor of nearly six in the unprotected state. The maximum peak-to-peak amplitude of vibrations on wires protected with the proposed dampers was well within the limits of permissible displacement. Figures 4; tables 1; references 8: 5 Russian, 3 Western.
[176-6610]

UDC 621.315.2.016.2.027.850.035.9

CHECKING THE CONDITION OF 500 kV CABLE LINES BY CHROMATOGRAPHIC ANALYSIS OF GASES DISSOLVED IN OIL

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 70-71

BEREZENKO, V. P., engineer, LIFSHITS, G. L., candidate of technical sciences, and SOLOSHCHANSKIY, V. A., engineer, Kirgizglavenergo (Kirghiz Main Power Administration)

[Abstract] The article describes a chromatographic technique developed by the All-Union Institute of Electric Power Engineering for checking the condition of cable insulation by analyzing cable oil for the gases that are typical of defects in power transformers: carbon dioxide, acetylene, methane and ethylene. This technique was successfully used for predicting breakdown of insulation on KL-2 cable at one of the hydroelectric plants of Kirgizglavenergo power grid 1.5 months in advance. The presence of the above-mentioned gases in cable oil can provide a signal for monitoring the state of cable insulation. Further research is needed in addition to more operational experience to work out criteria for objective evaluation of the state of cable lines. References 2 Russian.
[176-6610]

UDC 621.316.1:621.317.333.4

INDICES OF EFFECTIVENESS OF METHODS OF TROUBLESHOOTING 110-500 kV OVERHEAD TRANSMISSION LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 80 pp 53-56

AYZENFEL'D, A. I., candidate of technical sciences, Soyuztekhenergo

[Abstract] Statistical data on power systems for the period from 1971 to 1977 are analyzed in order to determine the results of installing and using locating equipment for finding trouble spots in electric networks with voltage of 110-500 kV. By the beginning of 1978, 91.3 percent of the total extent of overhead lines on these voltages had been equipped with locating devices for finding trouble spots. The average linear deviation of the error of locating damage according to data of 82 power grids in the Soviet Union in 1977 was 4.5 percent, which is lower than in preceding years. This error could be reduced by taking consideration of various factors that have been disregarded in troubleshooting in many cases. The effectiveness of damage

location in the case of unstable short circuits is 33 percent on the average, which could be improved to a considerable extent by using indicators of towers and strings with damaged insulation. On the whole, the locating devices made by the Riga Experimental Plant of Soyuzenergoavtomatika are operationally reliable. Figures 1; tables 4; references 4 Russian.
[176-6610]

UDC 621.317.32.027.3.001

ON ERRORS IN MEASURING THE PARAMETERS OF STANDARD LIGHTNING SURGES

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 1, Jan/Feb 80 pp 150-155 manuscript received 3 Apr 79, after revision 9 Aug 79

ABADZHIDI, G. YE. and KUZHEKIN, I. P., Moscow

[Abstract] An analysis is made of possible errors in measurement of the maximum amplitude and rise time of a standard lightning voltage surge both for the case of exponential response of the measuring instrument, and for the case where the response contains an overswing beyond the steady value. A mathematical model that describes the voltage waveform and the responses of the measuring equipment is used to analyze the criterion of suitability of measuring equipment recommended by the IEC (International Electricl Engineering Commission) and included in USSR State Standard GOST 17512-72. It is shown that a stricter criterion is needed for measuring devices with monotonically increasing transition curves, and also that the criteria in IEC recommendations for responses with an overswing are inadequate. The exponential response time for the monotonic component of the transition curve should be only half the IEC recommendation. In the case of a response with an overswing, there are negative time errors and positive amplitude errors that cannot be detected with the IEC approach. In such cases, evaluation of possible errors should be based on an approximating function. Figures 4; references 7: 5 Russian, 2 Western.
[177-6610]

UDC 621.3.049.75.001.3

MANUFACTURE OF PRINTED-CIRCUIT CARDS FOR ELECTRICAL ENGINEERING ITEMS

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 59-62 manuscript received 27 Oct 78

ADAS'KO, V. I., candidate of technical sciences, TIKHONOV, V. I., candidate of physicomathematical sciences, SLONIMSKIY, A. D. and SHCHERBAKOV, S. I., engineers

[Abstract] Principles which lead to a maximum gain in the productiveness of manufacture of printed circuit cards are obtained from an analysis of foreign experience. In USSR development of the technology and equipment for manufacture of printed circuit cards, some of these principles are sufficiently accomplished in succession; however, to realize them completely is by far not always successful. Work is described, conducted by the All-Union Planning and Design Institute of the Technology of Electrical Engineering Production (VPTIelektro), the All-Union Scientific-Research and Planning-Design Institute for Automated Electrical Instruments in Industry, Agriculture and in Transport (VNIIElektroprivod) and VNIIR (expansion unknown), the latter having much experience in stamping technology, useful, e.g., in making apertures in printed circuit cards. A table lists recommended methods of manufacturing printed circuit cards as a function of the requirements for density of installation. A number of other steps taken with respect to printed circuit cards are discussed. For example, the obvious path for productivity during manufacture of printed circuit cards is the use of group stocks of large dimensions. In so doing precision of fulfillment of crucial technological operations acquires particular value, which requires well thought out systems for combining various elements of the construction of printed circuit cards. The Istrinskiy Branch of the All-Union Order of the Red Banner of Labor Scientific-Research Institute of Electromechanics (VNIIEM) under the guidance of the All-Union Order of the Red Banner of Labor Scientific-Research Institute of Railroad Transport (VNIIZhT) developed a combination system which satisfies contemporary requirements during manufacture of printed circuit cards and multiple layer printed circuit cards. The system is based on the use of single fixing apertures in phototemplates and blanks, beginning with the operation of delineating the initial phototemplates by a light beam. The technology and equipment developed make it possible to obtain apertures in phototemplates with a diameter of 6 mm with a tolerance

zone of 12 micrometers and a between center distance of 270 ± 0.008 mm. Various other units developed and manufactured in the USSR are cited. Among them are conveyer installations for deposition and processing of printed layers on the basis of a dry film photoresist, for jet chemical processing of printed circuit card blanks in operations for preparation of the surface and etching of copper foil, and for the partial melting of the galvanic coating of tin-lead alloy. Studies are conducted, directed to intensification of chemical-galvanic processes, and for the creation of local automated systems for control of technological processes. In connection with the fact that many electrical engineering enterprises are equipped with high-productivity equipment for production of printed circuit cards, it is advisable to consider the condition and long-range improvement of the technology for manufacture of printed circuit cards which are introduced into industry from the point of view of carrying out the principles mentioned above. Tables 1; references 4: 2 Russian, 2 Western.
[167-6415]

UDC 621.313-181.4.001.1

DEVELOPING THE PRODUCTION OF SMALL ELECTRICAL MACHINES--A MOST IMPORTANT TASK FOR THE ELECTRICAL EQUIPMENT INDUSTRY

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 80 pp 2-4

NELLIN, V. I., Deputy Minister of the Electrical Equipment Industry

[Abstract] A major problem in the production of small electrical machines is their broad diversity, in terms of types and ratings, with an attendant nonuniformity of production volumes ranging from a few hundred to several million units annually. The trend in developing this sector of the electrical equipment industry is, therefore, toward reducing the diversity while at the same time meeting the increasingly stiffer demands by users as closely as possible. The way to accomplish this is by producing standard series based on market forecasts, service requirements, and scientific-technical developments in manufacturing materials and methods. A typical case is the rationally designed series of single-phase induction motors in the 0.6-180 W power range for household appliances, computer and automation equipment, and cinematography. The series includes capacitor motors with concentrated or distributed windings as well as shaded-pole motors. Engineering research on this series, based on target programming with the participation of user industries, has saved 8200 tons of electrical-grade steel and 1300 tons of copper annually, with an overall economic effect of 14 million rubles a year. The quality of these motors is comparable with that of the best foreign-made

ones. Another type of small electrical motors in a steadily increasing demand are permanent-magnet motors, the production of which is being also serialized. Contributing factors to increased demand for and production of small electrical motors is the availability of semiconductor converters and commutators as well as of simple and noiseless kinematic drive mechanisms. With standardization, more efficient continuous manufacturing processes become better adaptable to large- as well as medium- and small-scale production. Other innovations include use of programmed control for forming and finishing machine tools, use of laser beams for welding, new high-energy magnet materials and slotless winding methods. Progress is also made in powder metallurgy, enhancing the manufacture of bearings and magnetic parts.
[167-2415]

UDC 538.56:519.25

ANALYSIS OF ENERGY SPECTRA OF PULSE TRAINS WITH RANDOM AMPLITUDE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 33 No 1, 1980 pp 61-67 manuscript received 11 Jan 79

ZAMEK, I. G. and MALAKHOV, A. N., Gor'kiy State University

[Abstract] A number of problems involving discretization of the input signal or converted signal lead to the necessity for analyzing the spectra of pulse sequences with amplitude modulated by a random process. In this paper a formula is derived for the power of a random sequence with limited frequency band when pulse amplitudes are modulated by a stead-state process where Levin's expression for the energy spectrum of a random sequence is divergent [see B. R. Levin, "Teoriya sluchaynykh protsessov i yeye primeneniye v radiotekhnike" (The Theory of Random Processes and Its Application to Electronics), Sovetskoye radio, Moscow, 1957]. An expression is found for the energy spectrum of a pulse train when the pulse amplitude is modulated by an unsteady process. The energy spectra and signal-to-noise power ratios are analyzed for the case of modulation by processes of the flicker type. The results can be used to evaluate the influence of noises in telemetry, communications and control problems involving discrete representation of continuous signals when the noise band exceeds half the discretization frequency. Figures 2; references 5 Russian.
[155-6610]

QUANTUM ELECTRONICS

UDC 621.373.826

OPTIMIZING THE EMISSION FROM A 3-MIRROR GAS LASER WITH INTRACAVITY MODULATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 366-371
manuscript received 7 Jul 78

BLINOVA, G. V., DIANOVA, V. A., MANESHIN, N. K. and MUSTEL', YE. R.

[Abstract] Intracavity modulation of the laser light is particularly advantageous in laser with a small amplification. However, a lossy modulator placed inside the resonator cavity reduces the light intensity. The losses can be cut by means of a decoupling third mirror placed between the active medium and the modulator. This arrangement is equivalent to two coupled Fabry-Perot resonators, one active and one passive. Here a gas laser and such a 3-mirror system are analyzed, with modulation of the intercavity coupling on the basis of the linear electrooptical effect and with the period of the modulating signal much shorter than the transient period of the laser oscillations so as to ensure a constant light intensity in both resonators. Calculations show that the intensity of emitted light will be maximum with a control voltage which produces an alternating phase delay of the optimum amplitude, with the properly matched constant phase delay, and with a certain optimum reflection coefficient of the intermediate mirror. Calculations also show that the maximum intensity of the emitted light with intracavity modulation becomes much higher than in the case of external modulation, when the transmission coefficient of the modulator is larger than 0.5, while the necessary control voltage is much lower. The theoretical results have been essentially confirmed in an experiment with a He-Ne laser (wavelength $\lambda = 0.63$ μm) and with a crystal of potassium-deuterium phosphate as modulator (transmission coefficient $\partial = 0.95$). Figures 5; references 4 Russian.
[189-2415]

UDC 621.391

HOLOGRAPHIC METHOD OF PRODUCING A HIGH-CONTRAST READOUT IMAGE UNDER CONDITIONS OF A TURBULENT ATMOSPHERE

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 100-102 manuscript received 19 Jun 78

DUKAREVICH, YU. YE. and NARVER, V. N., Leningrad

[Abstract] Holographic construction and processing of high-contrast images in the focal plane of a telescope becomes difficult on account of atmospheric turbulence and diffraction at the transmitter optics. Here a holographic method of producing a high-contrast readout image is proposed which uses the interference of two coaxial wave fronts, one plane and one cylindrical. The principle of equivalent paths of interfering rays is realized to the fullest extent and, as a mathematical analysis in the Fresnel approximation demonstrates, the smallest possible microstructural dimension of the readout image is obtained. The maximum contrast and the width of the interference fringe depend on the ratio of the sphericity radii of the interfering wave fronts as well as on the diameter of the transmitter aperture, which forms the plane wave, a 100 percent contrast and a 0.2" wide interference peak at the null level being feasible with properly matched parameters. Figures 1; references 4: 1 Russian, 3 Western.
[179-2415]

RADARS, RADIONAVIGATION AIDES, DIRECTION FINDING, GYROS

UDC 621.396.1

SYNTHESIS OF A REFLECTOR THAT IS EQUIVALENT TO A STATISTICALLY UNEVEN SURFACE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23 No 2, Feb 80 pp 88-91 manuscript received 25 Dec 78; after revision 10 May 79

LANDE, B. SH. and DOBROVOL'SKIY, D. D.

[Abstract] The authors consider the problem of reflection of a radar signal by a surface with weakly developed roughness superimposed on a surface with considerable unevenness. Formulas are derived for the field strength of the scattered signal, the specific effective scattering area and the surface of perturbations. Spatial spectra are plotted for the surface of a synthesized reflector with different damping parameters. Calculations show that for a central wavelength of 3.2 cm, the working band of a reflector with damping parameter of 0.4 on the 70 percent level is limited to 2.98-3.41 cm. This is one-third of the total tuning range of the standard G4-126 generator. Figures 2; tables 1; references 2 Russian.
[185-6610]

UDC 621.396.96:621.391.26

EFFECT OF PHASE INSTABILITIES ON THE PERFORMANCE OF 2-FREQUENCY MOVING-TARGET SELECTION SYSTEM

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 22 No 12, Dec 79 pp 61-64 manuscript received 22 Aug 78; after revision 2 Feb 79

NOVIKOV, V. F.

[Abstract] The effect of phase instabilities between successive pulses on the performance, particularly the interference immunity, of a 2-frequency moving-target selector in a coherent-pulse radar system is analyzed. Such a system consisting of an exciter, two mixers, a modulator, a delay line, and a phase detector operates with difference signals on the basis of k-tuple

interperiod subtraction (most typically k= 2). As the performance criterion serves the subinterference visibility factor, namely the signal-to-interference power ratio at the output divided by the signal-to-interference power ratio at the input. With phase instabilities regarded as a stationary random process and the correlation functions of input signals in each channel assumed to be known, the correlation functions of output signals are calculated and an expression for the interference suppression coefficient is derived for any k and specifically for k= 2. This coefficient is then evaluated for various simple practical cases such as equal correlation functions for both channels and independent sources of instabilities in each channel. In other cases the effect of phase instabilities is not essentially different than in a single-frequency system. Figures 2; references 8 Russian, 1 Western (in translation).
[174-2415]

UDC 621.396.963

FEATURES OF AND POSSIBLE APPLICATIONS FOR A ZONAL FRESNEL DISK EXPOSED TO WIDEBAND FREQUENCY-MODULATED WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 409-412 manuscript received 6 Feb 78

BAZARSKIY, O. V.

[Abstract] A zonal Fresnel disk serves as an analog of a lens, but is designed selectively for a specific wavelength of coherent radiation. Here it is considered for passing a wideband frequency-modulated signal. For the purpose of analysis, such a disk is regarded as a hologram of a point source. On this basis, its focal parameters and characteristics are calculated according to conventional relations in lens optics. The results suggest four possible applications for such a disk with wideband frequency-modulated signals in detection of moving objects: 1) Scanning a focused antenna radiation pattern over range and angle; 2) Telemetry; 3) Formation of an image at a constant location and to a constant scale; and 4) Operational change of scale in the spatial spectrum. Figures ; references 4 Russian; 2 Western (in translation).
[189-2415]

SEMICONDUCTORS AND DIELECTRICS; CRYSTALS IN GENERAL

UDC 539.213:621.382

ELECTRON AND X-RAY SENSITIVE RESISTS ON THE BASIS OF CHALCOGENIDE FILMS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 74-79 manuscript received 16 Mar 79

KLIMIN, A. N., MAKAREVICH, V. S., REMESNIK, V. G., TREGUBOV, V. F. and TSUKERMAN, V. G., Novosibirsk

[Abstract] An experimental study was made of chalcogenide films (As_2S_3, As_2S_3-As_2Se_3, As_2Se_3) to determined their suitability as resists on the basis of selective dissolution in organic alkalinic solvents. Specimens of 2 μm thick films of these materials were vapor deposited with an electron beam on substrates coated with tin oxide or aluminum, then tested after storage in darkness at room temperature without further treatment. Bombardment by an electron beam (current density 1.3 $\mu A/cm^2$, accelerating voltage 25 kV), through a perforated mask of copper foil, was found to shift the optical absorption edge toward longer wavelengths and to appreciably increase the refractive index (by approximately 0.1). With aqueous solutions of dimethyl amine (5 percent, 33 percent) and diethyl amine (95 percent, 98 percent) used as solvents, the dissolution rate was measured as a function of the exposure time under electron bombardment. The largest contrast was revealed by As_2S_3 films, namely: the largest increase in the dissolution rate (positive dissolution) in 5 percent DMA and the largest decrease in the dissolution rate (negative dissolution) in 98 percent DEA. Similar results were obtained in an analogous experiment with x-ray bombardment. The authors thank M. N. KOROTKEVICH, T. I. LIKHOLETOVA, V. I. KUZNETSOV and M. A. SHEROMOV for the assistance in performing the experiments. Figures 4; tables 1; references 13: 7 Russian, 6 Western.
[179-2415]

UDC 621.317.335

STUDY OF THE ELECTROPHYSICAL PROPERTIES OF DIELECTRICS BY PROBING WITH PULSES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep/Oct 79 pp 60-64 manuscript received 27 Feb 78; after final revision 4 Oct 78

KORSAKOV, S. YA., KRYLOV, V. V. and PONOMAREV, D. M., Gorkiy

[Abstract] With the aid of a computer, it has become possible to study the electrophysical properties of dielectric materials over a wide frequency range by the method of pulsed probing. A specimen is placed inside a waveguide in the path of a train of electromagnetic pulses of 10^{-10} s duration. Signals reflected and transmitted by this specimen are fed to a stroboscopic oscillograph, then encoded and stored in the computer memory for further processing. Determination of the electrophysical properties by this method is based on Maxwell equations describing the propagation of electromagnetic waves and yielding the relaxation function. The latter characterizes the electrophysical behavior of a material in response to a pulse. In a practical experiment a specimen is placed between two waveguide inhomogeneities, which compound the transmission matrix of the specimen. Corrective extra measurements are needed, therefore, either only one or two (with two reference specimens) depending on whether or not the transmission matrices of those inhomogeneities are known. The method, with an apparatus including a minicomputer programmed for this purpose in the high-level FOCAL-69 language, was used for a study of polymers during their physico-chemical transformation (polymerization) and determining their electrophysical properties over the 0.08-10 GHz frequency range. The frequency spectra of dielectric relaxation were recorded in real time and plotted to different scales every 4 min, over a total period of 2 h, the results indicating any changes during liquefaction and formation of intermediate products. Figures 4; references 8: 3 Russian, 5 Western.
[179-2415]

UDC 621.382

LOCAL GENERATION WITHIN THE SPACE-CHARGE REGION OF METAL-OXIDE-SEMICONDUCTOR STRUCTURES AS THE CAUSE OF SHORTER RELAXATION TIME AT HIGHER VOLTAGES

Moscow MIKROELEKTRONIKA in Russian Vol 9 No 2, Mar/Apr 80 pp 107-113 manuscript received 23 Feb 79

V'YUKOV, L. A., GERGEL', V. A. and SOLYAKOV, A. N.

[Abstract] Dark relaxation in the space-charge region of charge-transport devices involves two processes: first fast relaxation due to avalanche breakdown and then slow relaxation caused by thermal generation. Involvement of the fast process, above a certain threshold voltage, appreciably shortens the total relaxation time. This anomalous voltage dependence of the relaxation time in an MOS structure, attributable to local generation, is here analyzed on the basis of fundamental equations describing the processes in such structures. Theoretical results indicate that, with increasing voltage, the relaxation time decreases also because of faster thermal relaxation. Experimental data obtained with MOS structures on n- and p-InSb, pertaining to the dependence of the relaxation time on the voltage and on the temperature as well as to the dependence of the generation current on the temperature and on the width of the space-charge region, essentially confirm the results of theoretical analysis. Figures 6; references 7: 3 Russian, 4 Western (1 translated).
[188-2415]

UDC 621.382

A METHOD OF ANALYZING METAL-OXIDE-SEMICONDUCTOR STRUCTURES IN WITH THE SEMICONDUCTOR SURFACE IN A STATE OF NONEQUILIBRIUM DEPLETION OF CHARGE CARRIERS

Moscow MIKROELEKTRONIKA in Russian Vol 9 No 2, Mar/Apr 80 pp 126-310 manuscript received 7 Feb 79

POPOV, V. M.

[Abstract] A theoretical analysis demonstrates the feasibility of producing MOS capacitor structures with the semiconductor surface strongly depleted of both positive and negative charge carriers at room temperature. Such a condition facilitates measurement of dynamic nonequilibrium current-voltage pulse characteristics of these structures for a determination of their electrophysical properties. The analysis is based on relations and equations

describing the generation of minority carriers, the impurity distribution and the rate of carrier generation, and the electron volume states upon application of an inverting ramp voltage rising at a rate of 0.1-10 V/s, sufficiently slow for automatic recording but faster than the rate of equilibrium inversion layer formation. It is possible, by controlling the magnitude of the capacitive generation current, to vary the pulse repetition rate and thus test MOS structures with almost any level of generation, including anomalously fast generation of minority carriers, as well as MOS structures on n^+ and p^+ diffusion layers. An experiment using a generator of ramp-voltage pulses, a generator of rectangular voltage pulses, an electrometer and a recording instrument has confirmed the practicality of this method. Figures 2; references 7: 1 Russian, 6 Western.
[188-2415]

UDC 621.382

HYSTERESIS DURING POINT EXCITATION OF AN AUTOWAVE DIFFUSION MEDIUM

Moscow MIKROELEKTRONIKA in Russian Vol 9 No 2, Mar/Apr 80 pp 141-143 manuscript received 20 Sep 79

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[Abstract] An autowave medium used as an active memory has been shown in an earlier study by the authors to be capable of intensifying a recorded image, emphasizing the edges, filtering out the low-order space harmonics, and converting a positive to a negative during the transient period of a data recording process. Here another computer experiment is described, which reveals a hysteresis in the process of recording two pulse perturbations within the space of such a medium. When two narrow rectangular pulses of certain polarities come closer together, than at a certain distance between them the resulting two local steady-state perturbations will merge into one. On the other hand when a single rectangular pulse widens, at a sufficient width the resulting steady-state perturbation will split into two local ones. Hysteresis manifests itself, in that the maximum distance at which two local steady-state perturbations will still merge is much smaller than the minimum distance which will separate them after a correspondingly wide single original perturbation has split. This phenomenon was simulated on a computer with a mathematical model describing an autowave medium by two coupled nonlinear equations of diffusion. The data are used for a graphical presentation of the pulse split and merger dynamics, with time as the third coordinate. The authors thank B. S. KERNER and V. V. OSIPOV for the discussion with helpful comments.
[188-2415]

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LOCALIZED STEADY STATES IN A TWO-DIMENSIONAL AUTOWAVE DIFFUSION MEDIUM

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BALKAREY, YU. I., YEVTIKHOV, M. G. and YELINSON, M. I.

[Abstract] An autowave diffusion medium with localized steady states is examined on the basis of a two-dimensional mathematical model, namely two coupled nonlinear differential equations which also describe the Zaikin-Zhabotinskiy chemical reaction with the two space coordinates representing the concentrations of reactants. These equations were solved numerically on a computer, according to the longitudinal-transverse grid scheme, by the methods of elimination and iteration. The results constitute an extension of those for the earlier solved one-dimensional case. Noteworthy is a dimensional effect: vanishing of longitudinal differentiation at the edge of a narrow-band signal and its reappearance with widening of the band to a square one. An explanation for this can be found in the inability to filter out low-order longitudinal harmonics in the presence of high-order transverse harmonics in a spatially narrow signal. The authors thank V. S. KERNER and V. V. OSIPOV for the discussion. Figures 6; references 8: 7 Russian, 1 Western.
[188-2415]

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CHARACTERISTICS OF THE ELECTRICAL ACTIVITY OF IMPLANTATION PACKING DEFECTS IN DEVICES WITH CHARGE COUPLING

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KRYUCHKOV, S. M., LAVRENOV, A. A. and KHAYNOVSKIY, V. I.

[Abstract] Existence of defects in devices on MOS structures such as devices with charge coupling depends on the quality of the raw silicon as well as on the design and the technology of these devices. Implantation packing defects near the surface can appreciably shorten the relaxation time in an MOS structure and cause local rises of the dark current, as a result of perhaps electrical breakdown or perhaps faster local thermal generation at the surface and in the bulk. A study was made concerning the

dependence of the electrical activity of such defects on the temperature and on the intensity of the applied electric field. This study was made by the charge coupling rather than the capacitance-time method. Specimens of 100-120 nm thick SiO_2 layers were produced by oxidation of silicon wafers in O_2+ 1 percent C_2HCl_3 at 1150°C, specimens of 40-60 nm thick Si_3N_4 layers were produced from monosilane and ammonia reacting in a hydrogen stream at 850°C. The dark current within a defective region was measured as a function of the temperature, with the amplitude and the duration of the embedded voltage pulse varied over wide ranges. The dark charge within a defective region was measured, at room temperature, as a function of the pulse duration and the pulse amplitude. The current-voltage characteristic and the activation energy of dark charge generation calculated on the basis of those data indicate that the electrical activity of packing defects near the surface produced during low-voltage (6-12 V) implantation is associated with local intensification of thermal generation through surface states at the $Si-SiO_2$ boundary and through deep traps in the Si surface layer. Figures 3; references 10: 4 Russian, 6 Western.
[188-2415]

SYSTEMS ANALYSIS

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ANALYZING THE EFFICIENCY OF ELECTRONIC APPARATUS DURING OPERATION BY USING A DIAGNOSTIC MODEL

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KOSTANDI, G. G. and SVITIN, V. P.

[Abstract] Technical diagnosis solves three main problems--analysis of the efficiency of the diagnostic object, finding the resulting defect and predicting the state of the diagnostic object. Determination of the real technical state of the diagnostic object with subsequent relation of it to a subset of efficient states or to a subset of inefficient states is the basis for solving the technical diagnosis problem. The diagnostic model of an object is formal description of the diagnostic object which reflects changes of its state. Differential equations, logic relations, signal transit patterns and so on are usually regarded as diagnostic models. A system of differential equations which describes the processes occurring in a nonlinear analog device is derived. It is shown that the volume of checks in analysis of efficiency can be reduced if there is a diagnostic model of an electronic apparatus represented in probability-regression form. The main structure of this diagnostic model is probability regression models of the components of the electronic apparatus circuits. The proposed diagnostic model of the electronic apparatus circuits can be used both during the operational stage and during the design stage. Figures 3; references 3 Russian.
[186-6521]

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